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THE HISTORY OF ANTHRACITE COAL IN NATURE AND ART.

BY JAMES S. LIPPINCOTT.

THAT our anthracite has been debituminized is evident, but whence the heat that has thus changed its character is not so clear. It appears, says Dana, that the change has arisen from some cause connected with the uplifting of the rocks which contain the coal. In the anthracite fields the coal beds have been violently contorted, and the angles of dip are frequently vertical, and in some instances the beds have been entirely inverted. This is doubtless due to the corrugations of the coating crust of the earth which, from some cause, has operated more violently in the eastern than in the western section of the coal basins. The anthracite beds lie in closer proximity to the granite and gneissic bases of the Silurian rocks which form the lower substratum of the base of the coal rocks and thus were more fully exposed to the heating action of the earth's nucleus, and more completely debituminized. The pressure of the vast accumulation of superincumbent rocks must not be disregarded as a probable source of heat, and consequent chemical change. Under the influence of the elevated temperature and the great pressure which prevail at considerable depths, sedimentary rocks which have been long accumulating, would acquire a certain degree of fluidity and approach a temperature nearly equal to that of redness, and thus we may find a cause adequate to debituminize the bituminous coals into the hardest anthracites.

The more closely the coal strata are studied, the more forcible becomes the evidence that they originated in the manner of mod-

ern deltas. That the wood and fine sand exist without pebbles, and are stratified with the leaves and roots of terrestrial plants, free in most part from any intermixture of marine remains, imply the persistence in the same region of a vast body of fresh water. This water was also charged, as is a great river, with an inexhaustible supply of sediment, and such as would drain a continent having within it one or more ranges of mountains. A bed of coal, even when purest, consists of distinct layers, though not usually separable unless quite impure from the presence of clay. These layers may be distinctly seen as alternating shades of black, even in almost any of the hardest specimens of anthracite. The researches of chemists have proved that wood burned in the earth and exposed to moisture and partially or entirely excluded from the air, is converted into lignite or brown-coal. A long period of decomposition finally changes this lignite into bituminous, and subsequent decarbonization through the increased heat of pressure or proximity to the heated earth, converts this finally into anthracite. The gases that result are the fire damp so destructive to incautious miners.

The processes through which the beds of anthracite has passed may be outlined as follows:

The coal was formed at the level of the sea and afterwards lifted to a vast height, but the shrinking and crumpling of the crust has flexed these beds and the many sand and clay and limestone beds beneath them; the frost and rains have broken them down and the waves of the ancient sea have repeatedly rolled over them as they have many times subsided to be again raised and again acted upon by agencies above the water. But a small part of these coal beds, and of the great masses of rock which once towered to such vast heights, remain, and the greater the elevation the greater has been the destruction. Our beds of anthracite are now found only where the subsidence was very great —in troughs caught in foldings of the underlying rocks, being often nearly vertical and doubled and re-doubled upon each other. The old rocks were worn down, after the once horizontal deposits had been made to stand on edge at various angles to the horizon; the soft clays and limestones and sands were then washed into the ocean, or gathered into the deeper depressions in the contorted strata.

The Carboniferous period opened with a marked change over

the continent. The red shales became covered with extensive beds of gravel or deposits of sand, which, hardening into a gritty rock, form the millstone grit and sandstone, which underly the coal measures. These fragments are the veins of some quartzose formations of former ages, which have again and again been cemented and re-broken, to repose at last a barrier against further destruction of the beds of coal. Forbidding as these barrier mountains may appear whence no valuable return could reward the cultivator, they may be regarded as proofs of the wisdom of the great architect who has provided that they should preserve, by their enormous eastward thickening, the secure basins hardened and toughened to resist further denudation, to become the strong storehouse of treasures more truly golden than all the glittering mines of Colorado and California.

"Coal," says Professor Newberry, "is entitled to be considered the mainspring of our [material] civilization. Wealth with its comforts, the luxuries and triumphs it brings, are its gifts, and its possession is therefore the highest material boon that can be craved by a community or nation." Coal is to the world of industry what the sun is to the natural world, the great source of light and heat, with their innumerable benefits. It is not only the principal generator of steam, but steam is also dependent upon iron, and the manufacture of iron is dependent upon coal, therefore these three most powerful among physical agents of modern advancement have their basis in the coal mine. "The exclusive possession of vast mines of anthracite within short distances from the seaboard, is one of inestimable value, and places Pennsylvania in an enviable position." "And it is difficult to say what vast populations its production alone will hereafter sustain, and to what height of power and importance it may ultimately elevate the State."

From Bethlehem we have followed the beautiful Lehigh, whose waters have been drawn largely into the canal, the massive walls and locks of which are a fitting measurement of the enterprise and indomitable energy of the father of the Lehigh coal business, and whose name is commemorative of the town which stands at the upper extremity of his noble work. The story of the efforts of Josiah White, of Philadelphia, and his indomitable pluck, deserves to be again and again rehearsed, conveying as it does a lesson of instruction to new men of new generations. It has been well told

by his son-in-law, from whose work we extract one short notice of the labors of this extraordinary man.[1]

To the sagacity and perseverance of Josiah White, we are indebted for the planting of the seed that has grown to such gigantic proportions in the anthracite coal trade of Pennsylvania. Josiah White and Erskine Hazard, his partner in the manufacture of wire at the Falls of Schuylkill, early learned that they needed a liberal supply of fuel, such as would alone be found in mineral coal. Having obtained a small quantity from the Lehigh in 1812, the earliest brought to market, one of the first experiments in having it for manufacturing purposes was made at their works. "Incredible as it may seem at this day, great difficulty was found in causing it to ignite, mainly from want of patience and from the deficient draft of the furnace in which the effort was made to burn it. An entire night was spent in the vain attempt, when in despair the workmen shut the furnace door and retired and left the coal to its fate. Fortunately one of them had left his jacket in the mill, and on returning for it in half an hour later noticed that the door was red hot, and upon opening the furnace was surprised to find the mass at a glowing heat. The other workmen were summoned and four separated pieces of iron were heated by the same fire and rolled, before it required to be renewed." The secret of kindling anthracite had been discovered. In 1814 a few ark loads were brought down the Delaware, but the public was very unwilling to purchase, for said many "the black stones will not burn." Bryant records the distrust with which it was viewed in "A meditation on Rhode Island coal"

"Dark anthracite! that reddenest on my hearth,
 Thou in those island mines dost slumber long,
But now thou art come forth to warm the earth
 And put to shame the men that mean thee wrong;
Thou shalt be coals of fire to those that hate thee,
 And warm the shins of all that underrate thee.

Yea, they did wrong thee foully, they who mocked
 Thy honest face, and said thou would'st not burn,
Of leaving thee to chimney-pieces talked,
 And grew profane, and swore, in bitter scorn
That men might to thy inner caves retire,
 And there, unsinged, abide the day of fire."

[1] Memoir of Josiah White, showing his connection with the introduction and use of anthracite coal and iron, and the construction of some of the canals and railroads of Pennsylvania, etc. By Richard Richardson. Philadelphia: J. B. Lippincott & Co. 1873. 12mo, pp. 135.

White and Hazard procured a new supply from the head-waters of the Schuylkill, paying forty dollars a ton delivered in wagons at their works. Believing they could supply the needs at a cheaper rate by making the Schuylkill navigable, they applied to the Legislature for the privilege. But through the ignorant misrepresentations of the member from Schuylkill county, who assured the Legislature that "the black stone would not burn," they were unsuccessful. They were not the men to be thus thwarted, and we find them soon active in organizing an association for the improvement of the Schuylkill, which resulted in the present Schuylkill Navigation Company, incorporated in 1815.

Having failed to obtain coal from the Schuylkill region, either by law for the improvement of the river or afterwards from the Navigation Company, White and Hazard turned their attention to the Lehigh region. Coal had been discovered on the Lehigh as early as 1792 and a Lehigh coal company had been formed, but without a charter, which had sent a small quantity to Philadelphia, but owing to the difficulties of navigation it early abandoned the business. Some of the coal it is said, was tried under the boiler of the engine at Centre Square, in the first Philadelphia water works, but only served to put the fire out, and the remainder was broken up and spread on the walks as gravel.

Josiah White visited the Lehigh region in 1817, and returned home favorably impressed with the practicability of improving the river and mining coal. In company with his co-partners he obtained a lease of the coal company's lands for *an ear of corn a year*, if demanded; obtained a charter for the improvement of the Lehigh, and soon in person sat about leveling it from Stoddartsville to Easton upon the ice, with the only leveling instrument to be found in Philadelphia. They at first constructed a turnpike road descending 1000 feet in the eight miles from the mines to the river. The road was superseded by the gravity railroad in 1827. Josiah White, in the construction of the dams and walls labored with untiring assiduity, dressed oftentimes in a red flannel shirt, roundabout coat, cap and strong shoes with a hole cut in the toe, to let out the water. "In the summer I was," says he, "as much in the water as out of it for three seasons and slept for the first two without a bed, in the same manner as the workmen."

In 1820, they sent the first anthracite to market by their arti-

ficial navigation, the whole quantity being 365 tons, which was more than enough to supply the families who would use it, although they never asked more than eight dollars and forty cents a ton. To overcome the objection many found owing to the difficulties found in igniting the coal, Josiah White made many experiments with different kinds of grates, fixtures in his office and at his house in Philadelphia, and had a fire in operation for the inspection of the public, which showed the complete practicability of using anthracite for household warming, cooking, etc.

Though the company was mining or rather quarrying the finest mass of coal yet known to exist, the difficulties in the way of selling the stock or extending the works seemed to increase; but "there is no difficulty to him that wills," and by allowing new subscribers extraordinary advantages, the company obtained means to continue the improvements. In January, 1823, they were declared finished, and in this year, 5800 tons were sent down the Lehigh, and but about 1000 tons were left on hand unsold in the following spring. Josiah White had, about this time, contrived the present plan of weighing coal in wagons, with a scale, the dish resting on four knife-edged fulcrums and compound levers. His genius seemed equal to any emergency. In 1824, they sent down 9540 tons. The public had begun to believe in the permanency of the supply, and new forms of grates and stoves having been introduced and the price kept steadily at eight dollars and forty cents per ton, the demand increased. Several patriotic ladies exhibited sample-fires, and their glowing grates warmed the indifferent to a zeal for anthracite, making it popular, so that, in 1825, the company sent 28,393 tons to market. In 1827 the railroad from Mauch Chunk to the mines was made, mainly upon the old wagon route laid out by Josiah White and Erskine Hazard, in 1818. This was the first railroad in this country constructed for the transportation of coal, and, with one or two trifling exceptions, the first constructed for any purpose. This was a gravity road, having a descent of 100 feet per mile for upwards of nine miles. After the mules, which had hauled back the trains, had ridden down with the coal in a car made for the purpose of carrying them, they could not be forced to walk down again, being ever ready to enjoy the luxury of a ride.

Josiah White thus divides with another enterprising Friend, or Quaker, Edward Pease, of Darlington, England, the honor of

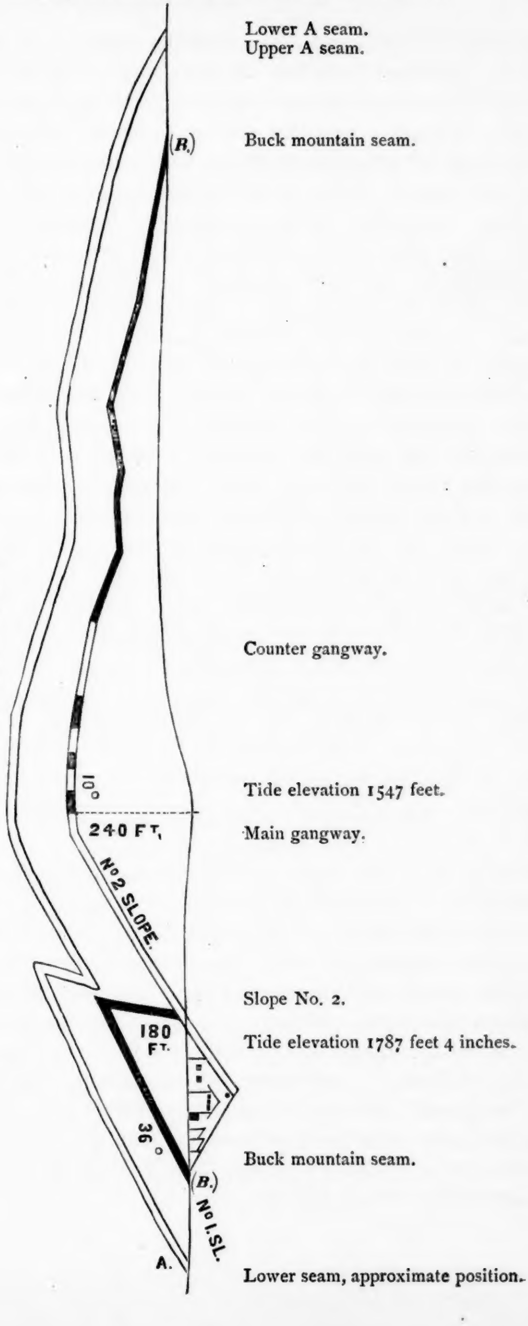
having been a pioneer of railway enterprise. Edward Pease was the father of British railway enterprise; and was, like Josiah White, "a man who could see a hundred miles ahead." He was a man of excellent business abilities, energetic, and of most persistent stuff. Having been placed upon a committee to devise improved modes of conveyance from Stockton to Darlington, thenceforth his heart was in the project of a railway, till the act was passed in 1823, and the first railway was opened for traffic Sept. 27th, 1825, thirteen months prior to the opening of that between Liverpool and Manchester. The road built through the influence of Edward Pease was intended to aid in developing the vast mineral resources of his district, and but for his exertions and that of his sons, another generation might have passed away before the people of the region benefited could have enjoyed the marvelous prosperity with which they have been favored. The enterprise, courage and pertinacious genius of one man has tamed the uncouth savagery of nature, changed the dashing torrent into a placid canal, turned the wilderness into a busy abode of happy industries, opened to day the treasures hidden for ages, and poured them out to bless his fellows and advance more rapidly the ever progressing course of human development. When from the summit of Mount Pisgah the admiring tourist gazes upon the wonderful scene spread before him, and regards the railroads with their immense trains of coal, the canal bearing its burdened boats, the activity everywhere visible in this hive of industry, let him turn to the memory of Josiah White, and apply to him the words as aptly written of another, *Si ejus monumentum requiris circumspice.*

Arrived at White Haven, we leave the Lehigh Valley road and take the Nescopeck branch. This carries us for nine miles up an incline which, at some places, rises upwards of 147 feet to the mile, while it follows seemingly every curve that could be readily devised in its winding track. Mountains are around us and above us, and red rocks and gray rocks and white sandstone—pebble rocks succeed in order piled in endless variety of attitudes—until we at length are deposited at the simple station at Upper Lehigh, and we have reached a height of 1850 feet above the sea. We are in the midst of a coal basin, small, it is true, but of immense value. The Green Mountain basin is but about two and a quarter miles in extent, and is worked at five slopes which supply

three immense coal-breakers and turn out annually 300,000 tons of superior coal. This basin exhibits the manner in which the beds have been laid down and corrugated very satisfactorily. Its twelve feet vein is the lowest workable bed, and is known as the Buck Mountain seam, one of the most valuable for furnace use. The blocks of white quartzose conglomerate lie in wild confusion around, a white sandy soil prevails, and a wilderness of whortleberry bushes, overtopped by sorrowing pines, are among the unattractive features of the landscape. We are compelled to look far away for beauty, and we find it in the long green masses of the Buck mountain, towering in the distance in the south, and in the hazy Pokono, sixty miles away to the east, in the dim distance. A pleasant walk of half a mile will bring us to a mass of giant rocks, from which we may look down into the wide and deep ravine bearing the repelling name of "Hell Kitchen," from the blasts of hot air that at times arise from its depths. From this pleasant outlook we may extend our gaze over and beyond the Butler valley, or Nescopeck, as it is also termed, to find our view bounded on the north by the mountains of that name which arrests our otherwise extended range of vision; even to the Wyoming mountain, the southern border of that valley long known to fame, and sung by Campbell as

> "Once the loveliest land of all
> That see the Atlantic wave the morn restore."

We will leave the scenery around us near and far, and devote ourselves for the remainder of this too extended paper to the unromantic but deeply interesting facts of coal mining. In wandering about the wilderness we came upon great sink-holes, which marked the places where the underpinning had broken and permitted the superincumbent mass of rock to descend. In these places there appeared a mixture of broken coal and sand, indicating the outcrop of the great coal seam. At a point near our hotel this has been opened, and a slope and steam engines and coal breaker, and all the busy industries of coal mining are vigorously in action. At the No. 1 slope the coal seam descends at an angle of about 30° until it has reached the perpendicular depth of 180 feet. The bed then rises nearly vertical, and approaching the surface, sinks again at nearly the same angle to the depth of 240 feet, and thence lies, as it extends southward, beneath and across the valley at an angle of 10°, more or less, being



SECTION THROUGH SLOPE 2 UPPER LEHIGH COLLIERY. 1880.

Scale 400 feet to the inch.

somewhat flexed from the level until it runs out on the southern edge of the basin. At the summit of the second dip another slope has been opened, and between these two slopes stands the giant coal-breaker, supplied with coal by the action of immense engines which draw, by means of wire rope, the loaded cars to its lofty height. The coal is drawn, in the second slope, up an incline of 424 feet by means of a wire rope 4300 feet in length, and nearly two inches in diameter. About 600 cars are daily hoisted by this rope, and the cars are drawn 174 feet up the incline within the breaker alone. This anticlinal, flexure, or saddle, brings into near proximity to the breaker a vertical mass of coal twelve feet in thickness and nearly 200 feet in height, and extending eastward and westward up and down the valley, to thin out as the conglomerate rises, basin-like, to its outcropping edge.

During 1880 there were three breakers in the basin, employing 389 men inside and 215 outside the mines. To open the mine and break up the coal from its beds 1514 kegs of powder, weighing twenty-five pounds each, were used, and the product of 330,444 tons of coal of 2240 lbs. each were sent to market. This valley and its plant for mining is the property of one family, and has proved, under their enterprise and energy, a princely domain.

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THE DEVELOPMENT OF THE MALE PROTHALLIUM OF THE FIELD HORSETAIL.

BY PROFESSOR DOUGLASS H. CAMPBELL.

AMONG the vascular cryptogams, perhaps none can be more satisfactorily studied than *Equisetum arvense*, both as regards the structure of the mature plant and that of the *prothallium*, the plant being a common one, and readily obtained for study. The growth of the fertile plant is very rapid, so that the cells are large and distinct, and being comparatively free from the silicious deposit so noticeable in most of the other species, it is much less difficult to examine. Finally, and what is of chief interest here, the spores germinate very readily if sown immediately after maturing, and offer a most interesting example, in their development, of the growth and division of cells. Within a few weeks of sowing, the antheridia are produced abundantly, containing antherozoids of extraordinary size, much larger than those of the mosses and ferns.

This paper contains the results of some observations upon the development of the male prothallium of *Equisetum arvense*, made in the botanical laboratory of the University of Michigan, in the spring of the present year.

Mature fertile plants were gathered on the 28th of April, and the following day the spores (Pl. 1, Fig. 1) were sown under glass, some in water and the remainder in damp earth. The second day after, while some were already divided into two cells, (Fig. 3), others had just begun to throw out the root hair (Fig. 2). Usually the first sign of active germination was the protrusion of a nearly colorless tube, the root hair (Fig. 2), followed very soon by a division of the body of the spore into two cells by a longitudinal septum (Fig. 3 *a*). Sometimes the second cell seems to be formed by a kind of budding (Fig. 3 *b*), but this, though not uncommon, is not the ordinary method. The root-hair grows with extreme rapidity, especially where the spores were growing in water (Fig. 4), and is destitute of chlorophyll, while in the body of the spore the chlorophyll is abundant. Almost immediately on the germination of the spore a very perceptible change occurs in the chlorophyll. While in the spore before germination the chlorophyll is evenly distributed throughout, as soon as germination begins there is a tendency in it to collect in distinct masses or chlorophyll bodies, which at an early stage in the development of the prothallium become very sharply marked. It is a difficult matter to give any definite rule for the method of cell division, as it differs so much in different individuals. Sometimes, though rarely, no root-hair is given off, the spore developing otherwise in a normal manner; again, in other cases there is a great enlargement of the spore without the formation of septa for a long time after germination commences (Fig. 8), (this was specially noticeable in the spores grown in water)—forming elongated flask-shaped cells.

On May 3d the spores presented the appearance shown in Figs. 4–6. Some were divided into four cells by longitudinal septa dividing the cells already formed, and in others (Fig. 5), the lower cell remained undivided, while the upper was divided into two, the cells having considerably grown in the meantime. No further change of importance was noted for several days, except a constant increase in the size of the cells. Figs. 7 *a b c* shows forms observed May 5th, the first showing a spore that seemed

to have divided into three cells at first, instead of two, as was ordinarily the case.

Many of the prothallia show a tendency to branch quite early, as is shown in Figs. 9 and 10, drawn May 8th. In these the basal cell remains undivided, and increases but little in length, while the others become elongated and divided by a longitudinal septum, forming two parallel rows of cells that finally develop into the two main branches of the older prothallium. This tendency is more plainly seen in Figs. 11 and 12, drawn at the same time from specimens that had developed further. In both of these the rows of cells have separated at the ends so as to plainly show the beginnings of the branches.

Sometimes, as in Fig. 14, there is considerable growth before any tendency to branching is shown; in this case the branch seeming to be formed by budding rather than by a division of the terminal cell. In contrast to this elongated form, there were numbers having the short thick form seen in Fig. 13.

Observations, made May 10th, showed that many of the larger prothallia had sent out a second root-hair from one of the lower cells. In some of the prothallia the branches also seemed inclined to divide again, thus forming four nearly equal branches instead of the two ordinarily present. This was more especially noticed in the case of spores growing in water, probably on account of the more nearly equal pressure on all sides, those growing on earth being flatter and having usually but two main branches. At this stage the chlorophyll bodies are remarkably distinct, being large and bright colored.

For some time after these observations were made, probably largely due to the unusually cold and dark weather, growth proceeded quite slowly, no noticeable change being remarked for almost a week; by the end of this time some of the more forward prothallia had assumed a distinctly two-branched form (Fig. 15), the branches being long and slender; from this point growth proceeded more rapidly, both laterally and longitudinally, the branches becoming flatter on account of the lateral growth of the cells and their division into new ones by longitudinal septa. The prothallia now begin to assume the irregular form that they have when mature, by giving off side branches at irregular intervals in which, as in the rapidly growing main branches, the protoplasm is strongly condensed at the ends (Fig. 16).

From this time on, the growth is very capricious; branches are given off, apparently without any definite order, the cells already formed also dividing, so as to make the prothallium broader and thicker. This growth continues until antheridia are to be formed.

For two or three weeks the spores grown in water and in moist earth, develop in much the same manner, but finally those in water grow much less rapidly, though seeming to retain their vitality to some extent. Their growth is more erratic, many growing for a long time without dividing, forming single cells that are very much elongated; others develop without sending out any root-hair, and nearly all, after three or four weeks, stop growing, or grow very feebly. When sown in water the spores soon sink and form a filmy green mass closely resembling a small alga. Those grown on earth form bright green, velvety masses that might readily be taken for a small moss. In both cases the long root-hairs, becoming entangled, make the prothallia cling together in great numbers where the spores are thickly sown. The abnormal development in water is probably owing to the lack of proper nutriment as well as to the different physical conditions to which the spores are subjected.

For a considerable time before antheridia were formed, the prothallia increased but little in length, but became noticeably broader and thicker, the ends of the main branches growing blunter and dividing up into short branches, so as to become somewhat club-shaped (Fig. 17). This process was slow at first, but after the first antherozoids were formed, there was a rapid increase in the size of the prothallium.

The first mature antherozoids were observed June 7th, nearly six weeks from the time the spores were sown; Fig. 20 gives the appearance presented by the prothallium at the time that the first antheridia are formed. Hofmeister gives five weeks as the time requisite for the production of the first antherozoids, but this difference of a few days in the time, may be readily accounted for by the extraordinary lateness of the past spring.

From the very great simplicity of the structure of the antheridium, it is very difficult to say just when it begins to be formed, for it is merely an excavation or cavity in the end of a branch of the prothallium that becomes filled with protoplasm more dense than that in the body of the prothallium. After the mature an-

theridia were formed, it was an easy matter to trace the development back, but it was impossible to determine just where it began. The process was as follows: After the branch in which the antheridium was to be formed had attained sufficient size, there was a concentration of protoplasm at this point (Fig. 18), a cavity being gradually formed, at first indistinct, but finally assuming a nearly regular oval shape (Fig. 19). This mass of protoplasm soon breaks up into small round bodies that are discharged as antherozoids. The first antheridia are formed singly, but later (Fig. 19) two or three are formed almost simultaneously at the end of a single branch. When the antherozoids are mature, the cells surrounding the interior cavity of the antheridium separate, leaving an opening by which they escape. Usually the whole mass of antherozoids is discharged in a few minutes, but sometimes the discharge is more gradual. Each antherozoid is enclosed in, and lies coiled up within, a membrane. After resting for a few moments this sac bursts, freeing the enclosed antherozoid, which immediately swims rapidly away with a peculiar undulatory movement due to its spiral form. The most noticeable thing about them is their great size, for while most antherozoids are so minute as to look like mere specks, even when a high power is employed, these are readily studied with an ordinary ⅔ objective. They are quickly killed by the application of iodine by means of which the cilia are made rigid, standing out in all directions from the thicker end of the antherozoid, and plainly visible with the low power. The body is long and slender, tapering to a point at one end and bearing the remains of the enveloping sac in the inner side. The body is contracted, becoming shorter and blunter after iodine is applied.

In germinating the spores, the only precaution necessary is to keep the atmosphere around them moderately damp. In making the foregoing observations, this was done by sowing the spores on damp earth in unglazed earthen saucers which were placed under bell jars. By giving water every two or three days no difficulty was experienced in keeping the prothallia in a healthy condition.

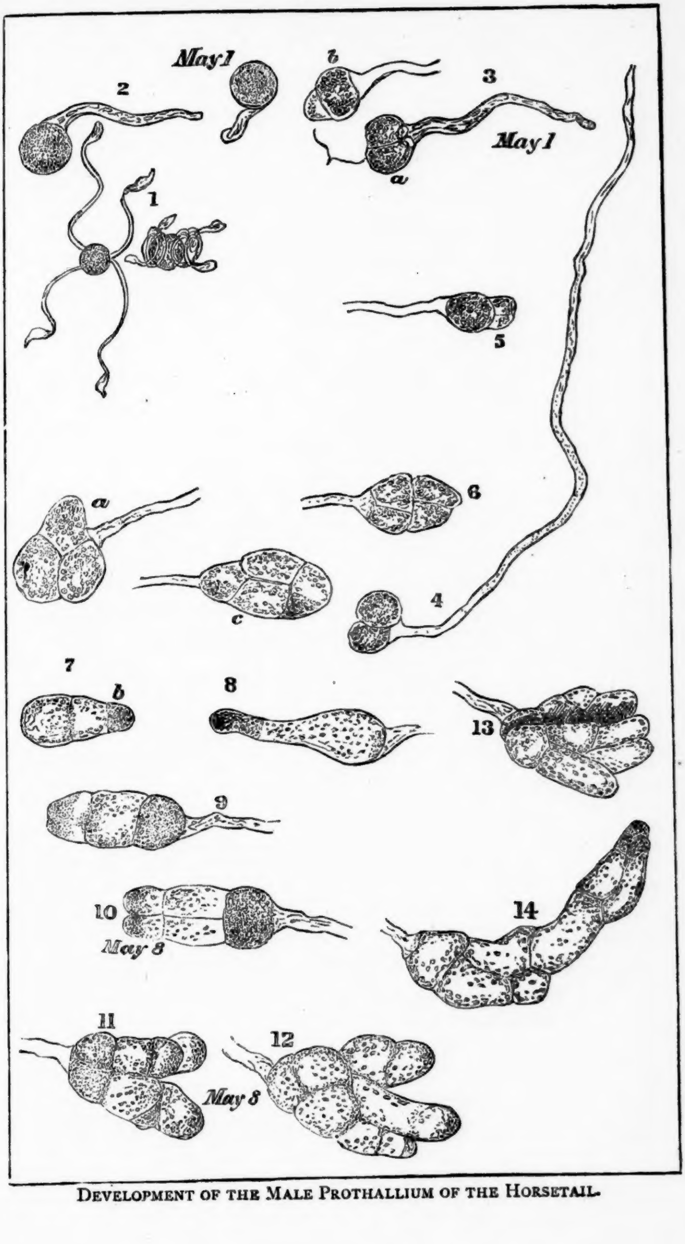
EXPLANATION OF PLATE I.

FIG. 1.—Two spores, one with the elaters coiled around it, the other with the elaters expanded.

FIGS. 2 and 3.—Germinating spores on May 1st.

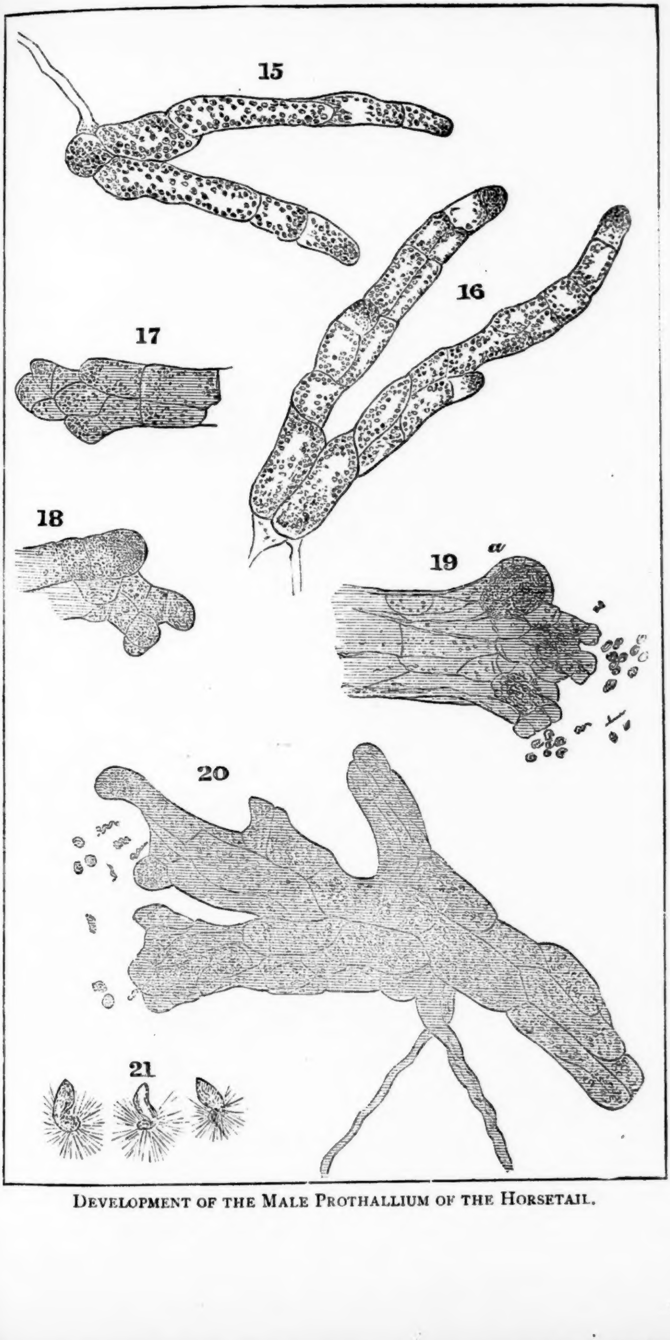
" 4, 5 and 6.—Germinating spores on May 3d, showing variations in mode of division.

PLATE I.



DEVELOPMENT OF THE MALE PROTHALLIUM OF THE HORSETAIL.

PLATE II.



DEVELOPMENT OF THE MALE PROTHALLIUM OF THE HORSETAIL.

FIGS. 7 and 8.—Germinating spores on May 5th, showing variations in mode of division.
" 9 and 10.—Young prothallia on May 8th.
" 11 and 12.—Young prothallia on May 8th, showing early branching.
FIG. 13.—Short, thick prothallium (May 8th).
" 14.—Young prothallium, much elongated (May 8th).
All the figures magnified 125 diameters.

EXPLANATION OF PLATE II.

FIG. 15.—Branching prothallium, May 18th.
" 16.—Branching prothallium, showing protoplasm condensed in the ends of the cells, May 24th.
" 17.—End of branch of older prothallium.
" 18.—Young antheridium.
" 19.—Antheridia; *a*, unopened; *b*, opened, with escaping antherozoid cells, June 13th.
" 20.—Prothallium with antheridia and antherozoids, June 10th.
" 21.—Antherozoids, mag. 350.
All the figures excepting Fig. 21 magnified 125 diameters.

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ON THE GEOLOGICAL EFFECTS OF A VARYING ROTATION OF THE EARTH.

BY PROFESSOR J. E. TODD.

THE fact of variation in the velocity of the earth's rotation, seems so nearly established as to call for a consideration of its effects on geology. One can scarcely read Professor Newcomb's masterly paper on the acceleration of the moon without feeling that the ability of astronomers to state the exact times of eclipses, especially of those in past time, has been greatly overrated. As he himself says in conclusion, "If Hansen is right, then Ptolemaic eclipses might be harmonized, but the Arabian would be ten to fifteen minutes out of the way, which to my mind seems very improbable. Apparently, therefore, we can hardly avoid accepting one of these propositions: Either the recently accepted value of the acceleration, and the usual interpretations of the ancient solar eclipses are to be radically altered, the eclipse of — 556 not having been total at Larissa, and that of — 584 not having been total in Asia Minor; or the mean motion of the moon is, in the course of centuries, subject to changes so wide that it is not possible to assign any definite value to the acceleration."[1]

We learn from this same paper reasons for believing that the

[1] Newcomb. Observations on the moon before 1750, p. 278. (Washington Ast. and Met. Observations, Vol. XXII, App. II.)

earth lost seventeen seconds in its rotation between 1750 and 1800, and has gained thirty-one seconds since 1800 A.D.[1] Also, that much greater variations may have taken place in the past, and yet escaped the observation of astronomers.

Mr. G. H. Darwin, in his paper on the Precession of the Viscous Spheroid, and on the remote history of the earth,[2] shows that if we assume a viscosity for the earth, such that a cubic inch, when subjected to a force of 13½ tons, would be distorted $\frac{1}{10}$ of an inch in twenty-four hours, and that such viscosity has remained constant, the retardation of the rotation of the earth has been such that 46,300,000 years ago a sidereal day was fifteen hours thirty minutes, and a sidereal month 18.62 days. As Mr. Darwin remarks: "It seems that we have only to postulate that the upper and cooler surface of the earth presents such a difference from the interior, that it yields with extreme slowness, if at all, to the weight of continents and mountains, to admit the possibility that the globe on which we live may be like that here treated of." Hence we may start with the assumption that not only is the rotation of the earth variable, but this variation is considerable.

It is proposed to present, in the treatment of our subject, first, a theoretical discussion of the case, secondly, a survey of related facts, and finally, suggestions to direct further investigation of the matter.

I. The rotation of the earth may be considered as the result of gravitation condensing it from its original nebulous or gaseous condition, The check to condensation we may consider to have been originally the expansive power of heat and the centrifugal component of its force of rotation. Now, however, we find the equilibrium of rotation lying between the following forces:

Forces affecting the rotation of the Earth. Those tending to accelerate are:

First. The contraction of the earth, especially in low latitudes. This, now, as in all past ages, is doubtless the main force on this side.

Second. The transfer of matter of any kind, from lower to higher latitudes. This may be (1) either by the transfer of liquid matter in the interior, attending a local depression of the earth's crust in lower latitudes, or (2) a transfer of water, either as vapor,

[1] See also *Am. Journ. of Sci.* (III), XIV, p. 408.

[2] Phil. Trans., Vol. 170, Part II.

water or ice, by some secular change in the earth. For example, the accumulation of ice at the poles during the glacial period. It should be noted here, that the circulation of ocean currents and aërial currents have no effect, so long as the sea-level remains constant. Every current, however strong, or whatever its direction, is counteracted by others. (3) A third case under this head, is the transfer of sediment, either by river or ocean currents. All streams flowing toward the poles conspire to this effect. The higher the latitude the more efficient the stream, other things being equal, but as the erosion is diminished by the cold, those in middle latitudes are probably the most efficient.

On the other hand, retarding influences are as follows:

First, and most unquestioned—the friction of the tides. The conditions in which this force would be most efficient have not, so far as the writer is aware, been satisfactorily stated. An alternation of oceans broad enough to accumulate the wave to its utmost, and of narrow continents, with shores adapted to raise the water to its highest point, and wholly check its flow, would seem perhaps the most favorable.

Second. The transfer of matter of any kind from higher to lower latitudes. The remarks made under the head corresponding, above, will apply equally well in this case.

Third. Any elevation of the earth's crust, either local or general, in lower latitudes, resulting either from increased heat, as near volcanoes, or from any bending of the earth's crust. If in the latter case, both the anticlinal and synclinal folds of the crust are in the same latitude, no change in rotation would result.

Fourth, and last, but by no means least, we would rather say greatest, a distortion of the earth's body by the attraction of the sun and moon. The degree of viscosity assumed by Mr. Darwin would seem to be little enough to satisfy the most ultra rigidarian or uniformitarian, and if a more yielding condition be predicated of the earth, certainly its effect will be indefinitely magnified.[1] Whether instruments will ever be invented delicate enough to measure its amount is doubtful.

[1] That this force is really efficient at the present time is attested by the influence of a variation in distance of these bodies on the occurrence of earthquakes. From the researches of Perrey, Volger and others, we learn that earthquakes are much more numerous when the earth is near perihelion than when near aphelion, and that they occur more frequently and with more violence when the moon is in perigee than at other periods.

To illustrate the efficiency of these different forces, we may refer briefly to the following calculations: The sinking of the equator 110 feet would shorten the time of rotation of the earth one minute, or if it was retarded one minute per day, it would produce eventually a depression of the equator 110 feet.[1] Erichson estimated that if the center of the Mississippi basin were 45° 55′, and its mouth 29° 8′, the sediment brought down by it would retard the earth .00036 of a second in a century. Ferrel, in 1853, assuming that the tide caused by the moon in the open sea is two feet in height, and that it is highest two hours after the culmination of the moon, showed that it would retard the earth at the equator fifty miles in a century.[2] For the retarding effect of the sun and moon on a viscous earth, see reference above to Darwin's paper.

2. *A Theoretical View of the Action of these Forces.*—We may conceive, therefore, the earth rotating in unstable equilibrium between these sets of forces. As will be seen presently, any change produces effects which tend to counteract the forces causing it. If the earth were wholly fluid, only two of the influences enumerated would remain, and they are those conceived to be most efficient now, viz., contraction from loss of heat, and disturbance from the effect of the moon and sun. A varying ellipticity would exist, because of the varying distances of the sun and moon on the one hand, and the cooling on the other, and there would be more or less regularity in this variation of ellipticity as the earth approached or receded from the sun or moon, in the movements of revolution. As soon, however, as the earth became a solid and rigid mass, as at present, either a decrease or increase of ellipticity would first show itself in the shifting of the waters of the ocean, so that the sea-level only would describe the resulting figure.

That is, if the earth were nearly perfectly rigid, and the rotation diminished continually, the sea-level would be continually lowering at the equator, and rising at the poles. If, on the other hand, by some cause the velocity of rotation were accelerated, the waters would rise at the equator and sink at the poles. By a little calculation, it will be found that the regions where the sea-

[1] Compare *Am. Jour. of Sci.* (III), XII, p. 353.

[2] Newcomb, Reduction and Discussions of Observations on the Moon before 1750, p. 11.

level would remain approximately stationary, would be near thirty degrees of latitude. It would describe a see-saw movement, as it were, around those parallels. The variation in altitude at the equator would be about one-half as much as at the poles, in any change in which the volume of the earth remained the same.

A decrease of velocity of rotation would, in this way, eventually lift the tropical lands so high above the sea, that their weight would become a force sufficient to cause their depression, which, in time, would either lift the tropical sea-beds, or the higher latitudes of both land and sea-bottom.

The former would have little effect to accelerate the earth's rotation, because the average altitude of equatorial continents and seas would remain the same. It would, however, have the effect to drive the waters still more toward the poles. Eventually, however, if not at first, equatorial lands would sink, at the expense of raising higher latitudes, and acceleration would result. This depression, when begun, would probably go beyond the point just sufficient to establish equilibrium in the earth's crust, and would continue, even while the rotation was being accelerated by the depressions. For momentum, in all known cases of vibration, carries the vibratory body beyond the point of rest. Any increase of acceleration would be closely followed by a rise of the sea-level, within the tropics, and a lowering of the sea-level outside, increasing in amount toward the poles. This, with the extra fall of the tropical crust, would turn the tide, eventually, to such an acceleration, that the polar regions would be much elevated above the sea, and in time they would begin to sink from their weight. This would become a retarding influence, which, with the continued retarding influence of the sun and moon, would produce a transfer of water to the higher latitudes, and so the cycle of one vibration would be complete. Now, if these two forces alone should act upon sea and land, there would be, on the whole, a running down, a graduation of vibrations into rest, only to be occasionally broken, perhaps, by varying astronomical relations; but another feature comes in to keep the great double pendulum swinging. The contraction of the earth will accelerate, by the depression of the tropical regions, and retard by depression of higher latitudes. This, therefore, would be a force to keep this vibration continued. The efficiency of this force can scarcely be questioned, at least for the earlier geological epochs, when we

think of the folds and faults of ancient strata. Thus far, we have not considered the effect of the movement of the waters, transfer of sediment, etc. The latter would be of comparatively slight efficiency, as before stated. The former would be considerable, and might act as a counter check, and in this way produce slight vibrations, superimposed, as it were, on those of more importance, which we have just considered.

These general movements of land and water need not conflict materially with the various local movements, which have been so clearly defined by various geologists. For example, the local folding of strata, and the elevation of mountains and continental plateaus; areas rising from local heating in the vicinity of volcanoes, and, on the other hand, depressions resulting from the accumulation of sediment.

These, in all ages, must have been numerous. Over areas where both the general and the local influences were acting, of course the result would be the algebraic sum of the two. Perhaps further investigations may discover that certain so-called local movements are indirectly the result of the general influence supposed. For example, in the downward movement of either high or low latitudes, we have supposed that it was attended with and partially the result of, contraction of the earth. This would be likely to be attended with an elevation of mountain ranges. The elevations along the lines of volcanoes crossing the tropical regions at the present time may, perhaps, be considered examples of such action. Another point should be added before we attempt a practical application of our theory. The neutral belts, as they may be called, between the areas of apparent elevation and depression, with respect to the sea-level, will be very variable. Some reasons for the variability will be, (1) The different ellipticity of the earth, at different ages; (2) The amount of contraction of the earth in any vibration; (3) The different capacities of ocean beds in different latitudes, and the consequent varying rate of change in the sea-level. This would affect especially the sea-level at the neutral belts.

II. So much for the theory. Let us proceed to compare it with recorded facts.

1. Changes during the present Epoch.

The first attempt to map the areas of depression and elevation was made by Darwin, soon after his interesting observations on

coral islands. His map has been often copied. From this, and the statements of numerous recent observers, we may establish the following generalizations:

1. Areas closely adjacent to active volcanoes, with very few exceptions, are rising. For example, Sunda islands, Sandwich islands, Philippines, West Indies, Central America, etc.

2. Extensive alluvial, and marine plains, rapidly formed, seem frequently to be areas of subsidence. For example, deltas of the Po, Indus, Ganges and Mississippi, Holland (?), New Jersey (?), North Carolina (?).

3. All islands, not volcanic, between the parallels of 30° latitude, bear signs of recent sinking; except Ceylon, of which some, however, report evidences of sinking, and Madagascar, which shows evidence of recent extinction of volcanic action.

4. The continents, within the same boundaries, not infrequently show signs of sinking. The Great Barrier reef testifies to the sinking of Northern Australia. From tropical Africa little is reported which bears upon our case.

South America is reported as sinking at the mouth of the Amazon, by Agassiz; as being bordered with barrier coral reefs, from Abrolhos islands to the equator, by C. F. Hartt. A sunken sandstone reef at Pernambuco, underneath the present one, is reported by J. C. Hawkshaw. Demerara is protected by dikes from the encroaching sea (F. M. Endlich). Upon the west side of the continent, although it may be considered a volcanic area, Von Tschudi reports a subsidence of the coast, at Peru, since its discovery. Bousingault, Proctor and Orton consider that there is strong evidence that the Peruvian and Columbian Andes have sunk considerably since the visit of Humboldt. Darwin reports a depression of Callao, by the earthquake of 1746.

Some exceptions should be noted under this head. Texas is reported to be rapidly rising. This may be due to its nearness to the probably rising axis of the Rocky mountains, which encroaches upon the tropical area. India seems to be rising at several points, as at Bombay, Sinde, Orissa, &c.

5. Areas outside of about 30° latitude are very generally rising. Avoiding, for the present, those near volcanoes, we enumerate:

In the northern hemisphere: Scandinavia, Scotland, France, Spain, North Africa (Reclus), Russia (Murchison), Spitzbergen (Lamont), Franz-Joseph-Land (Howorth), Siberia (Wrangell),

Saghalien and Manchooria (Smidt), North China and Japan (Pumpelly) Alaska (Dall), British Columbia (G. M. Dawson), California (Newberry), Hudson's Bay region (Bell), North Greenland (Kane), Labrador (Packard), Nova Scotia (Hind), New England[1] (Shaler).

In the southern hemisphere: Southern New Zealand (Haast), Southern Australia, Melbourne (Becker), Natal (Griesbach), Chili, Southern La Plata, and Patagonia (Darwin).

Some exceptional regions may be mentioned. A few have already been noted under a previous head, which may explain their occurrence. But the sinking of South Greenland, Southern Sweden, and others can scarcely be so explained. It seems better to refer them to local foldings of the earth's crust, which are progressing rapidly enough to neutralize the general elevation of higher latitudes.

From this survey we come very readily to the conclusion, that the facts confirm our theory, for an acceleration of the earth's rotation. Such, it will be remembered, is indicated by recent astronomical observations. And if it is objected, that it is believed that there has been a retardation for ages previous, we may reply, that the evidence is wanting, or at best, indecisive,[2] except for a very short time preceding this century. A brief counter-movement in a period of prevalent acceleration, would be no more than our theory would provide for.

We may therefore glance backward through the ages to further test our theory.

2. *Changes in the Early Quaternary.*

Preceding the present epoch, most geologists find abundant evidence of a depression, in high latitudes, at least in the Northern hemisphere, and far below the present altitude. The evidence from the southern hemisphere, for obvious reasons, is not so abundant. Yet Darwin gives very clear evidence for this point, from Patagonia, and Haast reports a similiar movement in New Zealand, and probably in southern Australia. There is equally abundant and reliable evidence, of a period of elevation of the

[1] New England is stationary according to observations of the Coast Survey for 1877. (*Am. Journ. of Sci.* (III), XXI, p. 77.) The rising of a few of the other countries given above, is also disputed. In such cases I have tried to weigh the evidence.

[2] Possibly the numerous islands in the tropical Pacific which Professor Dana reports as at present rising or stationary (*vide* Corals and Coral islands) are to be referred to such a case.

same regions, in the age preceding the depression just mentioned, and to an altitude far exceeding the present. As to relations of these periods to the prevalence of glaciers, there is not so complete harmony among geologists, but that need not affect our theory. Moreover this vast vibration seems to have had greater amplitude, in general, in proportion to nearness to the poles. This is well shown in the discussion of the matter by Professor Dana, in his Manual of Geology, pp. 552–558.

For the tropical regions in the same periods we cannot say as much. Comparatively few observations are reported which have any decisive bearing on their movements. It will be readily seen that we should expect a general elevation immediately preceding the present epoch.

Wallace, from his profound studies of the fauna and flora of Java, Sumatra and Borneo, concludes that they were submerged during the Miocene, but "at some later period a gradual elevation occurred, which ultimately united them with the continent. This may have continued till the glacial period in the northern hemisphere, during the severest part of which a few Himalayan species of birds and mammals may have been driven southward. Java was first separated by subsidence, then a little later Sumatra and Borneo."[1] He, from similar data, judges Celebes to be a fragment of the great eastern continent in perhaps Miocene times. This suffices to show a vibration in tropical areas, such as our theory demands, except that its time is not definitely determined. It seems not improbable that they may have been elevated through the Pliocene, been depressed during the Glacial epoch, then partially elevated during the Champlain, and again depressed, perhaps to a greater extent, which movement continues to the present, except where counteracted by volcanic influences.

From New Guinea and Australia we find nothing recorded which will throw any light on their movements, in the epoch preceding the present. Nor can we hope, perhaps, to find anything in the coral islands bearing on this stage of our case. It is barely possible that some of them which are much elevated, as Elizabeth island, Metia, Rurutu and others (*vide* Dana's Coral islands), may ultimately prove to be monuments of such an elevation as well as of a still earlier depression, deeper than that of the present. And if it be incredulously asked, What, then, has be-

[1] Island Life, p. 353.

come of the former tops of other islands, which certainly must have been in existence, to form the bases of many of the present atolls, and for a connecting stage between the successive depressions according to our theory? it may be replied, that they may have been carried away by the waves in the period of upheaval. We may, perhaps, see some evidence of this, where some atolls are themselves arranged in a ring-like form, as though an older atoll had been shattered, and each remnant became the center of a smaller one, as is the case in Atoll Ari, and in the Maldives generally.

Falling into the same line of argument is Darwin's observation of the terraces, on the Island of San Lorenzo, opposite Callao. He found there evidence of three terraces, and on the lowest, at an altitude of eighty-five feet, recent shells, but they were deeply corroded, and had "a much older and more decayed appearance, than those at a height of 500–600 feet on the coast of Chili."

Professor Dana, in his work on coral islands, argues strongly in favor of recent tropical depressions, in not only the Pacific and Indian oceans, but in the Atlantic also, even including many areas which Darwin considers to have been elevated. He also considers them as being compensated by elevations in higher latitudes preceding or during the Glacial period.

As before suggested, it does not seem to the writer necessary to assume a continuous subsidence from that time, perhaps interrupted with periods of stability, but rather that there may have been at least one time of considerable elevation intervening. Our hypothesis may assist in explaining certain problematic questions of this age, viz.: The occurrence of European plants in Australia, by the elevation of the tropical regions, at the proper time to form a bridge between the Palearctic and Australian provinces, and the occurrence of numerous edentates in North America towards the end of the Glacial period, by the elevation of the regions between North and South America.

3. Changes in Earlier Ages.

It is quite generally recognized by geologists, that in earlier times the land and sea were subject to oscillations of continental extent. Indeed, Europe and North America seem to have risen and subsided contemporaneously. Considering that conglomerates indicate recent elevation of the land, and perhaps a culmina-

tion of elevation, and that heavy deposits of limestone, on the other hand, mark a continued submergence, we may note nine great vibrations, to say nothing of several minor ones. We may enumerate the periods of depression, as the Huronian, Trenton, Niagara, Lower Helderberg (?), Corniferous, Sub-Carboniferous, Permian (?), Cretaceous, Later Eocene, and the Champlain already mentioned.[1] When we remember that these formations have been studied almost exclusively in the higher latitudes, and that we have seen reason, from later epochs, to believe motions of opposite phase, in lower latitudes, we may find it, as far as we now know, strong corroboration in our theory.

Before leaving this point, the writer would say, that after elaborating the theory as given above, he was pleased to find an almost identical view expressed by Dr. Dawson,[2] as follows: "We have seen, in the progress of our inquiries, that the movements of the continents seem to have occurred with accelerated rapidity in the more modern periods. We have also seen that these movements might depend on the slow contraction of the earth's crust, due to cooling, but that the effects of this contraction might manifest themselves only at intervals. We have further seen that the gradual retardation of the rotation of the earth furnishes a cause capable of producing elevation and subsidence of the land, and that this also must be manifested at longer or shorter intervals, according to the strength and resisting power of the crust. Under the influence of this retardation, so long as the crust of the earth does not give way, the waters would be driven toward the poles, and the northern land would be submerged, but as soon as the tension became so great as to rupture the solid shell, the equatorial regions would collapse, and the northern land would be again raised." This corroborating view, from so experienced a geologist, guarantees that the ideas presented above are not wholly visionary.

III. We pass on to indicate briefly certain important lines of investigation in connection with our subject.

(1.) A re-examination, from a mathematical and physical standpoint, of the possibility of such contraction of the earth, and such variation of its ellipticity, as this theory requires. Sir Wil-

[1] Compare Dawson, Story of Earth and Man, p. 178; Shaler, chapter on Ancient Glacial Periods, in his recent work on Glaciers; also, Dana's Manual.

[2] Story of Earth and Man, p. 291.

-liam Thompson thinks any considerable change of ellipticity in geological ages impossible. G. H. Darwin thinks the diminution of ellipticity in recent times not impossible.[1] Fisher, Dutton and others[2] considering the matter from different standpoints, declare against any considerable amount of contraction since the formation of the first crust. Mallet has estimated it at probably as great a figure as any one.

(2.) A more careful noting of the height of marine terraces in all parts of the world, and an accurate determining of their relative ages, as indicated by their fossils and degree of preservation. The common remark, "containing recent shells," is of little value.

(3.) A more careful study of the geological formations in tropical regions, and an especial noting of any signs of their alternating with similar formations outside. This, probably, may as readily be told, as in any way, by the comparative development of their forms of life.

(4.) A special study of the areas occupying the neutral ground, to discover, if possible, the over-lapping of formations, alternately from the higher and lower latitudes. Such areas should be chosen as have been as little disturbed by local causes as any. Those presumably the more favorable are Texas and Eastern Mexico. The Pampas and Australia. India, North and South Africa, are less favorable, at least, for the recent formations. The great variability of the neutral belts should be remembered, and the consequent extensive overlapping of strata. These areas may be found especially instructive, not only in determining the succession of strata, but in filling up the gaps in the series, both in the geological strata and the forms of life.

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ON THE BITE OF THE NORTH AMERICAN CORAL SNAKES (GENUS ELAPS).[3]

BY FREDERICK W. TRUE.

1. The facts presented below indicate clearly, I believe, that the North American coral snakes possess the poisonous characteristics of the family to a considerable degree, rendering their

[1] Vid. Nature, Jan. 5th, 1882.

[2] Vid. Fisher's Physics of the Earth's Crust, p. 75.

[3] Read before the Biological Society of Washington, Oct. 13, 1882.

bite dangerous or fatal in its effects. The somewhat general notion that they are harmless is erroneous. Incidentally it appears that the popular belief that certain serpents sting with their tail extends to the coral snakes.

2. On the afternoon of June 1, 1882, Mr. William Shindler, artist in the U. S. National Museum, was bitten in the index finger of the left hand by a specimen of coral snake, *Elaps fulvius*, received from Gainesville, Florida, which he had placed in his room that he might sketch it. The wound was inflicted between 2 and 3 o'clock, P. M. The serpent had not been fed for two months previously. It clung so firmly to the finger that it had to be pulled off. The first symptoms, which appeared immediately after the bite, consisted of violent pain at the wound, and extending up the arm to the left breast. The wound was cauterized by Dr. J. M. Flint. The symptoms continued without material change to half past four in the afternoon. At that hour, according to Mr. Shindler, the first symptoms of drowsiness or unconsciousness made their appearance, and remained until the morning of the 3d inst.

At 7.30 P. M. on the day of the bite, Mr. Shindler felt so ill that he deemed it prudent to call upon his physician, Dr. L. M. Taylor, of Washington. Dr. Taylor has kindly furnished me with a summary of the symptoms which he observed from the time the case came into his hands at the hour stated, until signs of recovery appeared, and of the treatment employed. The notes are as follows:

June 1, 1882. Case of William Shindler. Bite of coral snake; index finger, left hand.

Symptoms.—Finger swollen. Complains of acute pain extending up arm and down to region of heart. Partial delirium. Pulse at wrist of injured hand almost imperceptible; on other side weak, irregular, compressible. Skin cool, clammy. Tongue tremulous, cool, *white*. Nervous, excitable, garrulous. Eyes dull, stupid in expression; pupils contracted. Jactation, nausea, persistent vomiting.

Treatment.—Saturated bandage with strong ammonia water, and applied to wound.

Prescription.—Bicarbonate of soda....................4 drachms.
Sub-nitrate of bismuth..................1 "
Water sufficient to dissolve soda. Teaspoonful every five minutes. Administered six doses.

Symptoms.—Nausea returned; vomiting ceased.

Prescription.—Aromatic spirits of ammonia...............1 ounce.
French brandy..........................3 "
Teaspoonful every five minutes until six or eight doses had been given. Left patient comfortable. Tablespoonful every hour during the night.

June 2, 8 A. M. *Symptoms.*—Patient free from pain, pulse feeble, regular, still weaker on injured side. General condition much improved. Recovery certain.

Continue use of recipe every two or three hours.

In three days after treatment the patient felt in good health again. About two months after the event, however, pain set in once more at the bitten finger, extending to the knuckles, and after a few days an ulcer made its appearance above the latter.

At this date Mr. Shindler informs me that he is in good health, but that pain is felt from time to time in the bitten finger.

3. Desirous of learning whether cases like the preceding were common, I called upon Dr. Taylor, who referred me to several physicians in Texas. I received extended communications from Dr. Thomas Kearney and Dr. J. Herff, of San Antonio, which I append. I also caused search for parallel cases to be made in the catalogues of the library of the Surgeon-General's office, to which I gained access through the kindness of Dr. Robert Fletcher. The search proved fruitless, showing that few or no such cases have been hitherto recorded.

The following letter of Dr. Kearney, mentioned above, gives information of some cases of coral snake bite occurring in Texas, as well as allusions to the popular belief in serpent's stings and the treatment of rattlesnake bite:

SAN ANTONIO, TEXAS, *July 10, 1882.*

Mr. Fredk. W. True, National Museum, Washington. D. C.

DEAR SIR:—Your letter of June 19th, was received last evening on my return to this city. You wish me to give you whatever information I possess relative to the effects of the bite of the coral snake, treatment, &c., and whether any of such wounds have come under my immediate notice. In reply I must say that I have never seen or treated a case of coral snake bite. The snake is classed here as among the poisonous reptiles, and its bite is considered about as fatal as the bite of the rattlesnake. They are seldom met with in this portion of Texas. During my long residence in this State and in Mexico bordering on the Rio Grande, a period of nearly thirty years, I may have seen one or two dozen, and most of these, with few exceptions, I have met with in shady nooks or in thickly shaded thickets, out of which they seldom venture. This perhaps is one cause why they are not so often met with as the rattlesnake, whose habits lead him to seek open glades and prairies where he can enjoy his sunshine bath. From all the information that I have received as to the character of the coral snake, I have no doubt as to its poisonous nature, and it is the common belief among the people, that like the scorpion he is armed with a sting in his tail.

The following case of a bite of a coral snake, followed by death, occurred near Corpus Christi, Texas, during the last year of the "late unpleasantness." An infant child of Mr. Alexander Stringer was playing in the yard, and being attracted by the bright colors of a coral snake, grasped it near the middle. The screams of the child brought its parents to its relief, but too late, the snake had done its work. The

child lingered in great agony until the following morning and died as above stated. The snake, as described to me, was about eighteen inches long, and it is a matter of doubt with me whether the bite of so small a snake would have proved fatal to an adult. The year following this unfortunate occurrence I became a resident of Corpus Christi, and resided for several years within a hundred yards of Mr. Stringer, and he, as also many of the citizens, often told me of the sufferings and death of that child, and I will here add, that Stringer always contended that the snake did not bite the child, but inflicted the fatal wounds with the sting of its tail, and in this opinion he was not alone. About two years after this I was on a visit to my friend, Capt. R. King, the proprietor of a great stock ranch, Santa Gertrudes, forty miles from Corpus Christi. Walking across the court-yard one evening in company with Mr. R. Holbien, the book-keeper, I saw in the grass a small coral snake of sixteen or eighteen inches in length; I commenced annoying it with my cane to satisfy myself as to whether it had a sting or not; Holbien remarked, "be careful, that is the same kind of a snake that killed Stringer's child." Holbien was living in Corpus Christi when the child died. I pinned the snake to the ground with my cane, but could not induce Holbien to make close examination, he was afraid of it. My eyesight was very defective. I called Mr. Greer, the superintendent of the ranch, who happened to be passing at the time, and requested him to notice closely as to whether he could see a sting or not; he assured me he could see the sting very plainly whenever I pressed upon the snake sufficiently hard to cause it to strike with its tail. The motions of its tail indicated that it was used as a means of defence, whether it had a sting or not. I killed the snake and cut off an inch or more of its tail. The following morning I examined it as closely as I could; I found the terminal tip was constituted of bone of extreme hardness—almost flinty, in dividing it I had to force the knife through with a hammer. I found in the center a dark substance about the size of a hog-bristle attached only at its upper part, about one-half an inch from the apex of the tail. This limited examination gave me no satisfactory results, as my sight was defective and I had no magnifying glass to aid me; and notwithstanding Mr. Greer's assertion that he had seen the sting, I came to the conclusion that the black, thread-like matter I had noticed in the center of the bony case was probably the caudal terminus of the spinal cord. Since then no opportunity has presented itself to me for further investigation. I believe I have now given you all the information I possess relative to the coral snake, and regret that it is out of my power to give you anything more satisfactory. I will add that the coral snake, as met with in Southwestern Texas and in Mexico bordering on the Lower Rio Grande, seldom exceeds thirty inches in length; all that I have seen, with few exceptions, ranged in length from twelve inches to twenty-four.

In the treatment of the bite of the coral snake, I would adopt the same course of treatment as in case of the rattlesnake bite or that of any other poisonous reptile. I have noticed the same train of symptoms follow the sting and bite of the centipede, the bite of a diminutive spider found occasionally here and in Mexico, which is followed by an alarming train of symptoms if not soon arrested, and the bite of the copperhead, moccasin and rattlesnake. I have seen an infant die in ten hours after being stung by a centipede, but have never heard of a death of an adult from the same cause, though I have had many come under my notice. When my attention has been called in time, I have never failed to cure a snake bite (rattlesnake) with Bibron's mixture, bandaging the limb above the wound, scarifying freely, and bathing it for several hours with tincture of iodine, alcoholic stimulants being freely administered when the temperature and pulse indicated its use.

I have treated cases successfully when no other antidote was at hand, by giving internally and externally tincture of iodine, and using whisky, *ad libitum*, to keep up temperature and pulse.

Remedies to be successful in such cases must be applied very soon after the wound is received. When delayed too long the vital forces sink rapidly, and when the patient ceases to complain of pain, death is close at hand.

Very respectfully, your obedient servant,

THOMAS KEARNEY.

Dr. Herff's letter contains information of two additional cases, one proving fatal, the other having the most serious consequences. He writes as following:

I know two cases where persons were bitten in the finger, where the back-teeth of the serpent could come into action, and one died in twenty-four hours, while the other one recovered after an almost fatal prostration of thirty-six hour's duration.

Different from our common poisonous snakes the bitten part would neither swell nor become discolored, but the poison acted more as the poison of the sea-serpents (hydrophis and platurus) is described to act. For sometime nothing is felt but a glowing heat over the body, which is soon followed by total prostration, very small and slow pulse and absolute suppression of urine. The fatal case I know of came under my observation a few minutes before death occurred under the symptoms of paralysis of the heart. The second case was brought soon enough for me to try stimulants, whisky, hypodermic injections of ammonia and fomentations of digitalis leaves over the region of the kidneys. The man, a strong young Scotchman, recovered in three days and felt only a feeling of tingling in his extremities for some time after.

In neither case unconsciousness, vomiting, or bleeding from nose or mouth occurred, nor could anything be observed on the wound, except the small impression caused by the teeth of the serpent. Both men kept the snakes as pets and the last one used to put his finger in the animal's mouth very often to show how tame he was. One day he put it in a little deeper than usual and while trying to extricate it the teeth bit him.

I may add that before I had these experiences I used to handle snakes of that species myself frequently and had no hesitation to catch them with my hands, although I never tried the experiment for which the poor Scotchman paid so dearly. Different from other snakes, it does not try to bite, but when you handle it winds around your hand with considerable force and for such a thin animal with a very firm grip.

4. A recent letter from Mr. James Beel, of Gainesville, Florida, to Professor Baird, and by him kindly transmitted to me, contains some matters of interest relative to coral snake bites. I quote from it as follows:

"I have known for some time that the coral snake was poisonous, quite as much so as the rattlesnake, but I did not know but what there were two kinds, one poisonous and the other not. A gentleman and a little child were killed in West Florida, where I formerly lived, by snakes bite, and, 'tis said, by this kind of snake. The poison, however, was not so rapid in its effects. I once put a grass snake and one of these coral snakes into a large glass pickle-jar, and the coral snake bit the other, which died in a few minutes thereafter. Mrs. Bell was watching them at the time, and thinks it did not live over five minutes after being bitten. I have tried fre-

quently to get them to bite or to find their fangs, but have never succeeded, although I did not examine very closely."

Mr. Shindler informs me that he tried a similar experiment with the snake which wounded him, with a like result.

Mr. Swartz, of Washington, related to me another case which occurred in Crescent City, Florida, in which the poison did not seems of a very virulent nature, the bad effects yielding readily to such remedies as the person bitten was able to apply.

5. That coral snake bites are of quite rare occurrence seems due (1) to the lack of abundance of these serpents, especially about towns; (2) to their sluggish disposition, and (3), as Duméril has remarked, to the small size of the mouth, which prevents them from fastening upon any but a sharply curved surface. Elapsoid serpents are not so little obnoxious in all countries as in North America. They are the scourge of India.

6. Numerous writers of the first half of the present century, and later authors as well, refer to the habits and characteristics of the North American and smaller South American coral snakes.[1] The majority, while alluding to their close relations to the very venomous sections of the family *Elapidæ*, regard them as the innocent members of the group.

7. I am indebted to Mr. Shindler for permission to publish the case in which he was the principal; to Dr. Taylor for the medical summary of the same; and to Dr. Kearney, Dr. J. Herff and Mr. Schwartz for information of the other cases cited. Also in an especial manner to Professor Baird, and indirectly to Mr. Bell, for the use of the communication of the latter observer.

——:o:——

ACHENIAL HAIRS AND FIBERS OF COMPOSITÆ.

BY PROFESSOR G. MACLOSKIE.

THE large order of Composite plants has so much unity of structure, that characters scarcely of specific value elsewhere, are here used for the separation of genera and for limiting sub-orders. Any attempt towards the discovery of additional tribal characteristics is therefore excusable. I have been examining the surface of the achenes, the hairs growing from them and their internal structure, and have found characters scarcely noticed by previous

[1] Duméril and Bibron: Erpétologie générale. Holbrook: North American Herpetology, iii, 1842, pp. 50–51. Jordan: Manual of the Vertebrates, 1878, p. 183.

writers, and running on the lines of the general affinities of the groups.

The achenial hairs of *Senecio vulgaris* and of *Doria (Othonna)* long ago attracted interest; they are double, each having two tubes with a partition between, like the two flues of a double chimney, and they contain within their interior spiral fibers or elaters which are rapidly unwound on the access of moisture, swelling and escaping by the tips of the tubes, as by the lifting of a pair of trap-doors (Fig. 1).

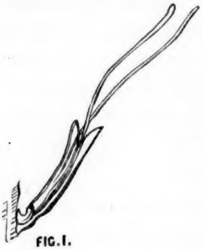

FIG. I.

FIG. 1. — Duplex hair from fruit of *Senecio vulgaris*, the elaters protruded.

I have found that other species of the genus Senecio have similar hairs. *S. viscosus* L., is represented by De Candolle and by Hooker and Arnott as having glabrous achenes; and *S. triangularis* of Colorado is similarly described by Porter and Coulter. But both these species have duplex achenial hairs with elaters, though less conspicuous than in *S. vulgaris;* and the same is true of the two varieties of *S. aureus*, *balsamita* and *borealis*. The duplex hairs abound most on the angles of the achenes, and are mounted on a pedestal consisting of a pair of cells apposed like the guard-cells of a stomate.

The achenial hairs of Ruckeria, belonging to the sub-order Calendulaceæ, were shown nearly half a century ago, by Decaisne, to agree with those of Senecio. In examining other genera of the Calendulaceæ, I find that in some cases the achenes are glabrous, and that *Calendula arvensis* has multicellular hairs on its achenes like those of the perianth. This I take to be a case of the encroaching of perianth hairs on a neighboring region, which occurs in a number of genera; there being still room for an intermediate set of duplex hairs. I believe that I have found these in Calendula, though not so clearly as to make out its affinity with Senecionidæ (Fig. 2).

A FIG. 2. B

FIG. 2.—Multicellular (A) and duplex hairs (B) from fruit of *Calendula arvensis*.

In the sub-order Inuloideæ the achenial hairs are duplex and obtuse, and mounted on pedestal-cells, like those of Senecio, but *devoid of elaters.* They manifestly represent the elater-bearing hairs already described, and one is tempted to think that they must have shed the elaters, but we have found no traces of such structures even in young flowers (Fig. 3.)

The Asteroideæ and several other sub-orders have duplex hairs without elaters, the two divisions being acute at their tips, more or less divergent, generally unequal in length, one of them being sometimes very short (Fig. 5). These are a further modification of the Inuloid pattern, and some Asteroideæ (as the English daisy (Fig. 4) and *Baccharis ivæfolia*) are of the Inuloid type, whilst *Pluchea fœtida*, placed by Bentham and Hooker among the Inuloids, agrees in this respect with the Asteroids, where DeCandolle placed it in the Prodromus.

In many instances achenes represented by authors as smooth, have some of these duplex hairs indicating their real affinities; and

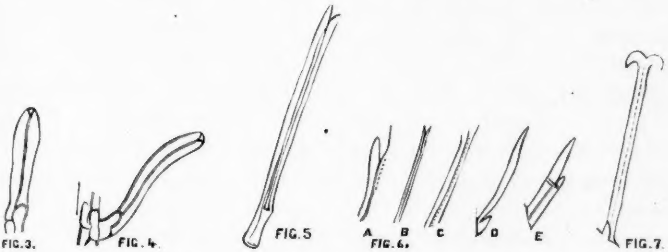

FIG. 3.—Duplex hair, with pedestal-cells, of fruit of *Gnaphalium norvegicum* (Inuloideæ). FIG. 4.—Similar hair of daisy (*Bellis perennis*, of Asteroideæ). FIG. 5.—Duplex hair of fruit of *Erigeron strigosum*, the regular Asteroid type. FIG. 6.—Various forms of duplex achenial hairs: A, of *Sericocarpus conyzoides*; B, of *Chrysopsis villosa*; C, of Eupatorium sp.; D, of *Liatris scariosa*; E, of *Eupatorium glechonophyllum*. FIG. 7.—Duplex hairs of fruit of *Townsendia grandiflora*, showing the recurved tips.

in other instances (as *Chrysopsis villosa* and *Sericocarpus*,) the duplex hairs are very long and fine, as if they were simple hairs; but still their Asteroid character is easily seen (Fig. 6 B). They are sometimes confined to the achenial angles, the intermediate areas bearing glands. Archer refers to such achenial hairs being bifid at the apex as existing very extensively among the Compositæ (Proc. Linn. Soc., 1861, p. 17), and Kraus briefly speaks of them (Pringsheim's Jahrbücher für Botanik, 1866–7). In Townsendia they diverge at the tips so much as to become recurved (Fig. 7). As some species of this genus have glabrous achenes Professor Asa Gray has made the presence or absence of such hooked hairs the ground of splitting the genus into sections. We now see that such distinction depends on the greater or less development of a structure that belongs to all the Asteroids and to

other tribes of Compositæ. It is not improbable that we may find rudiments of the hooked hairs even in such of the species as are described as having glabrous achenes. Descriptive botanists may fairly characterize parts as "smooth" when hairs, if present, are not prominent; but in seeking to find the affinities of tribes and genera, we must do our utmost to detect hidden marks, and thus the structure of these hairs has a higher significancy than the degree of their development.

Duplex hairs are general in Asteroideæ, Eupatorieæ, Vernonieæ, Helianthoideæ, Helenioideæ, Arctotideæ, and Mutisieæ, but we have found no trace of them in Anthemideæ or in Cicharieæ. The Cynaroideæ appear to me to present two types of structure; some genera (as Carlina and Xeranthemum) agree with Asteroideæ; whilst the true thistles agree with Cichorieæ. Centaurea (*C. nigra*, *C. scabiosa*, *C. terniflora*) has the achene covered with long simple bristles, like those of the perianth. This is, however, a case of perianth hairs encroaching on the seed-vessel; in some cases (as *Callistephus chinensis*, the China-aster) many-jointed hairs like those of the perianth are intermingled with duplex hairs on the fruit. Engelmannia (of Helianthoideæ) is said by Bentham and Hooker to have sub-pilose achenia, but here it is pilose bracts which enclose a glabrous achene; and the same is true of the aberrant Ambrosia. *Tagetes erecta* (the large African marigold, of Helenioideæ) has the achenial hairs short and lanceolate, but its congener, *T. patula*, shows that this is a mere variation of the duplex type. In some cases where we should expect to find duplex hairs, a cursory examination will suggest that they are simple; but here a closer view is apt to show the rudiment of the missing half, like a small twin brother, at base of the larger part (as *Liatris scariosa*, Fig. 6, D.). It is always the basal division of the cell which is less fully developed. The partition between the chambers of the duplex hair is usually pitted, and sometimes we could chase air-bubbles up and down the tubes.

The genera of Anthemideæ have, nearly all of them, glabrous fruits, the exceptions being glandular, and very few sub-pilose. I have not seen any of them with hairs; but I find epidermal cells enclosing spiral threads, in *Maruta cotula*, *Anthemis arvensis* and Leucanthemum. (Fig. 8.) *Achillea millefolium* seems not to have these, but its pericarp has internal glands within its cells.

The achenial surface of the sub-order, Cichorieæ, is devoid of hairs, and is covered by imbricating flat denticulate cells. The inner cells of the pericarp develop fibers, enclosing crystalloids, which aid in the dehiscence of the fruit, much after the manner of the fibrous layer of pollen-sacs. Thus I found the so-called indehiscent fruit of dandelion in the act of dehiscing, by the aid of its fibers, when moistened, pressing out the seed, and of its crystalloids serving as props and wedges, the tapering form of the seed being well fitted for the process.

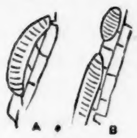

FIG. 8.

FIG. 8.—Epiderm. of pericarp of A, *Maruta cotula* and B, *Leucanthemum vulgare*, showing cells enclosing spirals. (Anthemideæ.)

Krigia virginica has simple red-brown spines over its fruit, and chicory has elegant multicellular hairs, corresponding with the perianth surface. The thistle group of the Cynaroideæ agree as

FIG. 9

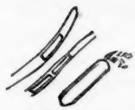

FIG. 10.

FIG. 9.—Denticulate epidermal cells of pericarp of *Lactuca scariola* (Cichorieæ).
FIG. 10.—Endocarpal fibrils and crystalloids of *Cirsium lanceolatum* (Cynaroideæ).

to absence of double hairs, and as to the fibers and crystalloids with the Cichariaceæ.

Professor Asa Gray suggests that the mucilaginous filaments of Senecio are probably of service by gluing the achene to the soil, its pappus being thrown off. There is much mucilage in and about the filaments of the Cichorieæ, and it will be an interesting question to determine what are the functions of these and the crystalloids.

The consideration of the facts stated above suggests a somewhat different line of affinities from that usually adopted, and a reëxamination of the tribal unity of Cynaroideæ. We give the orders in the subjoined table, according to the arrangement of Bentham and Hooker. But it is manifest that Anthemideæ and Arctotideæ and Mutisieæ are misplaced, and that other readjustments are to be made, if we are to marshal the groups according to the character here discussed. Yet the parallelism between the structure of the hairs and the affinities of the groups, as founded on other characters, is singularly complete.

In many instances apparent exceptions turned out on reëxamination not to be exceptional; and although our work has been only tentative, enough has been found to demand the attention of synantherologists.

TABLES OF ACHENIAL HAIRS, &C., OF COMPOSITÆ.

I. Vernonieæ: as in Asteroideæ.
II. Eupatorieæ: do.
III. Asteroideæ. Duplex hairs, usually bifurcate, and often unequal, acute at tips. Hairs sometimes few or obsolete: sometimes as in Inuloideæ. No elaters.
IV. Inuloideæ. Duplex hairs, usually obtuse and equal. No elaters.
V. Helenioideæ: as in Asteroideæ. Crystalloids in endocarp.
VI. Anthemideæ. Achenes usually glabrous; but having pericarp cells with spiral filaments. (Glands in Achillea within pericarp cells.)
VII. Senecionideæ. Duplex hairs, having divisions equal, with elaters or filaments, which escape when moistened.
VIII. Calenduleæ, probably as in Senecionideæ (with multicellular hairs interposed in some).
IX. Arctotideæ, as in Asteroideæ.
X. Cynaroideæ. Some as in Asteroideæ (*Carlina*, *Xeranthemum*). Some as in Cichoriaceæ (*Cnicus*, *&c.*). *Arctium*, *Centaurea*, *Echinops*, &c., have simple hairs on achene like those of perianth.
XI. Mutisieæ, as in Asteroideæ.
XII. Cichorieæ. Achenes glabrous, with denticulate epidermal cells. Endocarp having filaments, enclosing crystalloids.

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INSTINCT AND MEMORY EXHIBITED BY THE FLYING SQUIRREL IN CONFINEMENT, WITH A THOUGHT ON THE ORIGIN OF WINGS IN BATS.

BY F. H. KING.

IN June, 1879, I obtained a litter of three flying squirrels, *Sciuropterus volucella* (Pall.) Geoff., from a nest built of small twigs and oak leaves, lined with grass, which was situated about ten feet from the ground in a small red oak standing in a grove of the same kind. The nest was a complete ball, from which the inmates escaped without any specially provided opening. No large trees of any kind exist within two miles of the grove, the locality, in its topography and vegetation, being an extension of the Minnesota prairies into Wisconsin.

The squirrels, so small when taken as to escape very readily between the wires of an ordinary canary-bird cage, became very tame and playful at once, they grew rapidly upon cow's

milk, which they lapped from the dish in the manner of a cat, except that the nose was held closer to the milk, so close, indeed, that it was with difficulty that the movements of the tongue could be observed.

They were strictly nocturnal and, at first, had regularly two frolics each night, beginning at 10.45 P. M., and at 3.30 A. M., which lasted from an hour to an hour and a half. During the whole of the first week of their captivity, the beginning of these frolics did not vary five minutes from the time stated, but after this they became more irregular in their beginning and more frequent. Their play consisted in running, jumping and gnawing simply, with nothing whatever of that rollicking roll-tumble-and-pull of the kitten. A favorite sport, out of the cage, consisted in climbing to some elevated point and then leaping and sailing to some distant lower level. Their early efforts in this direction were truly amusing; when the point of departure was reached, all fours were brought very near together and the head dropped with the nose pointing forward; in this attitude a number of quick vibrations of the body to and fro upon the feet, were made, which always suggested to me the act of winding themselves up preparatory to the leap, and the number and intensity of these vibrations was usually proportionate to the distance to be covered. They were not very accurate marksmen in the beginning, and oftener shot over the mark than under it. I was glad of this, too, for a favorite leap of theirs during their early efforts, was from the books on my secretary to the top of my head when sitting at the desk reading or writing. Not once did one of them alight on my nose or slide down my face, but very often they shot past my head, sliding down my back and even plunging through the back of the chair to the floor without touching me, to return by way of my legs to the station again, resolved to make a better record next time.

In their flight-like leaps, the four limbs were extended in such a manner as to throw them all into very nearly the same plane, thus stretching the parachute-like expansion of the skin tense and wide. It is interesting to observe, in this connection, that while on the flight, and especially just before alighting, the fore limbs are made to make a series of rapid and short vibrations not wholly unlike the movement in true flight. The fact may have been noted, and the thought which follows uttered by

others, but I have not observed it in my reading. Have we not in the modified structure of the flying squirrel, and in the tremor of its fore legs while sailing, the true key to that further modification in the bat which gives it the power of flight?

The common squirrels when they jump from any considerable height to the ground, have the habit of extending the legs in the manner of the flying squirrel, and at the same time of broadening the body very much horizontally; this is of manifest account in reducing the energy of impact due to the fall, and suggests possibly both the method and the occasion for the modification now possessed by the flying squirrels. The traction brought to bear upon the integument between the limbs in the effort to spread the legs, must stretch it, and may be supposed to have begun a modification which was perpetuated and intensified by natural selection until the modification in the flying squirrel was reached. The habit of spreading the legs may have had its origin partly in the mere effort to balance the body and maintain the desired attitude for alighting, and partly in the knowledge obtained experimentally in repeated acts of jumping.

It does not seem improbable that the development of wings in the bat may have been initiated in the same manner and have passed along essentially the same road, that is, the earlier ancestors of the bats may have had a dermal modification nearly identical with that of the flying squirrels, and which may have been used in much the same way for similar purposes. The next step, probably, in the development of the bat's wings, was the forming of the habit of vibrating the fore limbs together in a vertical plane, and the embryonic phase of that movement, it seems to me; may be represented in the tremor of the limbs mentioned as occurring in the flying squirrel under consideration.

In the effort to maintain the proper attitude of the body, we may have had the initiating factor; for if they were originally provided with parachute-like appendages, and used them as the flying squirrels do, it is probable that a similar vibratory movement would have been a necessity in order to keep the body in the attitude which would present the greatest surface to the air in falling. With the vibratory habit fixed, increased skill in executing it would of necessity prolong the leaps, and this is another step towards flying; and increased use and greater advantage

would operate, through natural selection, to bring about the final modifications.

I have never known wild animals that became so perfectly familiar and confiding as these young squirrels did; and they seemed to get far more enjoyment from playing upon my person than in any other place, running in and out of pockets, and between my coat and vest. After the frolic was over they always esteemed it a great favor if I would allow them to crawl into my vest in front and go to sleep there, where they felt the warmth of my body, and it was very rare indeed, during the first six months, that they failed to ask the privilege; indeed they came to consider themselves abused if turned out. When forced to go to sleep by themselves, the attitude taken was amusing, the nose was placed upon the table or other object it happened to be upon, and then it would walk forward over it, rolling itself up until the nose almost protruded from between the hind legs; the tail was then wrapped in a horizontal coil about the feet, and the result was an exquisite little ball of life in soft fur which it seemed almost sacrilegious to touch. If they escaped from the cage during the night, I was sure to be warned of the fact by their coming into the bed to roll themselves up close to my face or neck. They would very rarely return to the nest in the cage to sleep when the play was over. One of them found its way, while clambering about on the bed, between a pair of flannel blankets where it went to sleep near the foot, and always after that, if left to himself, he would find that spot to sleep.

So far as I observed, they exhibited no lonesomeness when left without a playmate, nor did I ever observe them play with one another, neither did they quarrel.

Before I procured a suitable cage, one of the three squirrels escaped. The other two derived great enjoyment running in the wheel, and in this sport the two would very often participate at the same time, but not, apparently, because the enjoyment was greater. In this sport one of them was so unfortunate as to break one of his hind legs above the heel; I splinted it carefully for him, securing the splints with thread. To this treatment he objected emphatically, scolding and pinching much during the operation, and when I returned at noon he had cut the threads and removed the splints. I could not replace them until evening; when I could attend to the little patient he was placed in my

hand, where he lay upon his back without a struggle, nor offering to bite, except once when the pain seemed greater than he could endure, and then he only pressed his nose against my finger with his mouth closed. During the whole operation those keen, full, black eyes gazed steadily into my own without following, so far as I could observe, the movements about him. He did not remove the splints a second time, nor did I see him make any effort to do so. When the bones had knit together sufficiently, I removed the splints, and he used his leg well but it was a little stiff.

Did this squirrel, after wearing the splints for a short time, find that the pain was more intense without them than with them? Did he discover on removing the splints an increase of pain, and connect that increase as an effect with its cause? Did he connect the presence of the splints upon his leg for the first time with the treatment he had received in the morning? Had he reached the conclusion that the first treatment was for his relief and, therefore, would submit to a second treatment? Had he learned through his experience with the first splint on and off, that it was, for the time, the right thing in the right place? And did that experience lead to a decision not to remove the splints a second time? If these questions are answered in the affirmative, this little squirrel manifested no low degree of intelligence.

Before the month of October following the capture of these three squirrels, two of them had escaped, Skip alone remained and in regard to his preferences as to kinds of food, it may be said that he preferred nuts to anything else, but would also eat apples, cakes of various kinds and bread with apparent relish. Occasionally he would take a little fresh meat, both raw and cooked, but the amount was always small. While the three squirrels were together and quite young, I introduced a large moth, *Saturnia io*, into the cage; this resulted in a frantic struggle on the part of the squirrels, each struggling for the moth; it was soon captured, the wings torn from the body, and the fleshy abdomen, charged with eggs, eaten by one of them. They would also capture and kill any beetles placed in the cage, but would rarely eat them. I once introduced a young chipping sparrow alive, not yet feathered; it was seized instantly and killed, but no part of it was eaten. Two squirrels of the same species which I

now have in confinement eat birds' eggs with great satisfaction, even when plenty of nuts of three kinds are before them.

After the weather began to grow cold I placed, one evening, on the floor a handful of acorns before Skip was let out. He began his frolic as usual, and finally ran upon them.

The circumstances were such that the acorns awakened in him a new and intense emotion which in an instant seemed to fill his whole being to overflowing. For a few minutes he appeared transformed into a wild squirrel and went bounding about the room shying from objects with which he was perfectly familiar, and starting at the slightest noise. He soon returned to the pile of nuts and took one of them in his mouth, running with it to a corner of the room, where he made a hurried, eager effort to bury it, thumping the acorn upon the floor as if he was endeavoring to push it beneath the surface. After from three to five thrusts, made as rapidly as one can count without separating the words, he made as many strokes with his fore feet upon the carpet, scratching as if to cover the acorn up. This done he hurried back to the pile of acorns, seized another, rushed back to the same corner again, going through the same motions as before. I kept his pile supplied, and he worked during a full half hour, depositing a few nuts in all corners of the room, behind table legs, behind the books in my secretary and in the pits made by the tie-buttons in all the upholstered chairs. The next evening before letting him into the room, I placed an assortment of nuts upon the floor, among which were acorns, hazel-nuts, hickory-nuts, pecans and English walnuts, all of which he had been fed upon frequently, exhibiting but little preference for either, so far as I observed.

On discovering the pile, Skip did not appear agitated as on the previous evening, but set at once to carrying off the acorns and hazel-nuts, hiding them with the same motions as before; but to my surprise he touched none of the other nuts. I tried him on succeeding nights with the same, and to me strange results, for acorns and hazel-nuts are the only ones that grow in the vicinity where the squirrels were taken. The pig-nut hickory is found in abundance not more than ten miles distant.

Have we here inherited mental attributes so strong as not only to originate the generic act of storing up nuts on the approach of cold weather, but so specific a form of it as a selection of the two

kinds of nuts from among three others which, beyond much question, were the only ones of the five named with which his near ancestors had anything to do? It should be stated in this connection that the squirrel had eaten of the other nuts during at least two months prior to the selection in question, with as much apparent relish as he evinced for either the hazel-nuts or acorns. This particular squirrel, only about five months old, had had no experience whatever with nuts except in confinement, and of course had never before attempted to bury them. Have we in this instance and in similar ones, evidence that an act, executed repeatedly during particular seasonal conditions, and under certain sense-impressions, as sight and smell, may impart so definite a set to the organization as that it shall be transmitted to an offspring? Is this set a molecular one and located in the nervous tissue? Is it so sensitive that if, when the body is experiencing those seasonal changes due to the change of seasons in the earth during which the original set had its origin, a combination of vibrations (those accompanying the sight and smell of an acorn, for example) like those which were instrumental in producing the set, are again imposed upon the nervous tissues, similar feelings will be awakened which tend to culminate in a desire like the ones which had prompted former generations to the act in question? And in this way to a repetition of that act? Did not Skip on the night in question experience a true recollection in which the memory he had inherited was jogged by the combination of the sight and smell of acorns and the systemic feeling of approaching winter?

On the 27th of June, 1880, I left Skip with a little girl to be cared for during my absence, which lasted through the summer; when we met again, about the middle of September, Skip showed unmistakable signs of a distinct remembrance of me by playing upon my person, in his usual manner, with great freedom. The most decided test, however, of his keen memory, was exhibited when he was allowed to play in the closet where Mrs. King's wardrobe hung beside my own. He played with unusual vigor and for a long time upon my garments, running in and out of pockets, but exhibited great caution in touching hers, only alighting upon them to jump to some of mine. He had never seen Mrs. King before the evening on which this frolic occurred.

THE EXTINCT RODENTIA OF NORTH AMERICA.

BY PROFESSOR E. D. COPE.

THE order of Rodentia appeared in the Wasatch[1] Eocene epoch in North America, and has continued to the present time in gradually increasing numbers. No species of the order is yet known from the Puerco or lowest Eocene, nor are any known from older formations. The Wasatch Eocene has given us but few species, and these are members of a single genus. In the Bridger epoch the number of species was larger, and they belonged to several genera. The order displays a sudden expansion in the White River or Oligocene epoch. We know from this formation ten species of seven genera. From the John Day River formation we have twenty-one species of nine genera. The Upper Miocene Loup Fork epoch has yielded remains of nine species of seven genera. Four existing genera are represented by extinct species in the Miocene beds; two of these begin in the White River and two in the John Day epochs.

The four primary divisions of the order Rodentia are thus defined, principally after Brandt and Alston:

I. Incisor teeth $\frac{2}{2}$. Fibula not articulating with the superior condyle of the calcaneum. No intertrochlear crest of humerus.
   1. Mandible with the angular portion springing from the outer side of the bony covering of the lower incisor. Fibula distinct from tibia. "Malar bone not supported below by a continuation of the maxillary zygomatic process." An interpterygoid fissure . . . HYSTRICOMORPHA.
   2. Mandible with the angle in the plane of or springing from the inferior edge of the covering of the alveolus of the inferior incisor, more or less rounded; coronoid process high, falcate. Fibula distinct from tibia. No interpterygoid fissure.................. SCIUROMORPHA.
   3. Mandible with the angular portion springing from the inferior edge of the sheath of the inferior incisor (except Bathyerginæ). Fibula coössified with the tibia. Malar short, usually supported on a maxillary process. No interpterygoid fissure (except in Bathyerginæ)...... MYOMORPHA.

II. Incisor teeth $\frac{4}{2}$. Fibula articulating with the condyle of the calcaneum. An intertrochlear crest of humerus.
   4. No true alisphenoid canal; fibula ankylosed to tibia below; angle of mandible in the plane of the incisive alveolus............ LAGOMORPHA.

These groups, as is well known, include families and genera which display adaptations to various modes of life. Some are exclusively subterranean, others are arboreal, and some live on the surface of the ground. Of the latter, some are provided with formidable spines as a protection against enemies, while others depend for their safety on their speed. Of the latter character are

[1] For the positions of the American Tertiary epochs, see AMERICAN NATURALIST, 1882, March.

the Rabbits of the Lagomorpha, and I have noted[1] how that they have superadded to the ordinary rodent structure certain points which also characterize the most specialized Perissodactyla and Artiodactyla among ungulates. The fusion of the inferior part of the fibula with the tibia (found also in the Myomorpha) belongs to the higher types of these orders. The strong intertrochlear ridge of the humerus is an especial feature of the groups mentioned, distinguishing them from the lower types in all the orders. The articulation of the fibula with the calcaneum, mentioned by Mr. Alston, is a character of the Artiodactyla. Associated with these is the elongation of the bones of the limbs, especially the posterior one. The modification of the tarsus in Dipus (the jerboas) evidently has a direct relation to the projectile force transmitted through the hind legs in rapid progression by leaping. Here the metatarsals are coössified into a cannon bone, though, as there are three bones involved, the result is somewhat different from the cannon bone of the Ruminantia.

	Wasatch	Bridger.	White River.	John Day.	Loup Fork.
HYSTRICOMORPHA (porcupines).					
Hystricidæ.					
Hystrix L.	......	......	......	......	1
SCIUROMORPHA (squirrels).					
Mylagaulidæ.					
Mylagaulus Cope	......	......	......	......	2
Fam. ?					
Heliscomys Cope	......	......	1	......	......
Castoridæ.					
Eucastor Leidy	......	......	......	......	1
Castor L.	......	......	1	2	1
Ischyromyidæ.					
Plesiarctomys Brav.	3	7	......	......	......
Syllophodus Cope.	......	2	......	......	......
Ischyromys Leidy.	......	......	1	......	......
Sciuridæ.					
Meniscomys Cope	......	......	......	4	......
Gymnoptychus Cope	......	......	2	......	......
Sciurus Linn.	......	......	1	2	1
MYOMORPHA (rats).					
Muridæ.					
Eumys Leidy.	......	......	1	......	......
Hesperomys Waterh.	......	......	......	1	1
Paciculus Cope	......	......	......	2	......
Geomyidæ.					
Pleurolicus Cope	......	......	......	3	......
Entoptychus Cope	......	......	......	5	......
LAGOMORPHA (rabbits).					
Leporidæ.					
Paleolagus Leidy	......	......	4	1	1
Panolax Cope.	......	......	......	......	1
Lepus Linn.	......	......	......	1	......

[1] Bulletin U. S. Geological Survey Terrs. IV, 362, 1881.

After a general view of the species and genera, some deductions as to the course of evolution of the order will be presented.

Eocene Rodentia.

Plesiarctomys Bravard.

This is the prevalent genus of Rodentia of the Eocene period in North America. Specimens were first discovered by Dr. Hayden in Bridger beds of Wyoming, and were described by Dr. Leidy. I subsequently detected them in the Wasatch formation of New Mexico. Their remains are rather abundant in both formations, but display but little variety of form.

The teeth have short crowns and long roots, and have the general characters as well as numbers as the existing species of squirrels. There are, however, cranial characters which distinguish it from the existing forms of that family. The crowns of the infe-

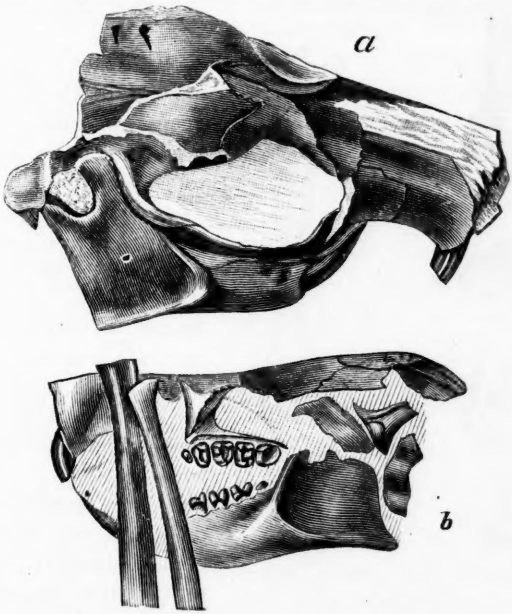

Fig. 1.—Parts of two crania and the ulna and radius of *Plesiarctomys delicatissimus* Leidy, natural size, from a block of the Wasatch bed of the Big Horn river, Wyoming. Original, from Vol. iv, Report U. S. Geol. Surv. Territories.

rior molars support four rather small and strictly marginal tubercles. There are five superior molars, of which the anterior is of small size. They resemble those of Sciurus, but the transverse

crests are obsolete or wanting. The positions corresponding to their external extremities are marked by more or less distinct cusps. There is a single internal tubercle of the crown. In the third and fourth molar of *P. delicatissimus* I observe rudiments of a second internal tubercle. The incisor teeth are compressed, with narrow anterior face. The enamel is not grooved, and is little or not at all inflected on the inner side of the shaft, while it is entirely so on the external face.

There is a large round *foramen infraorbitale exterius*, like that of Ischyromys and Fiber, and entirely unlike that of Gymnoptychus and Sciurus, conforming in this respect to the forms of the extinct group of the Protomyidæ of Pomel.

The cast of the brain indicates smooth oval hemispheres, which leave the cerebellum and olfactory lobes entirely exposed. The latter are ovoid and expanded laterally.

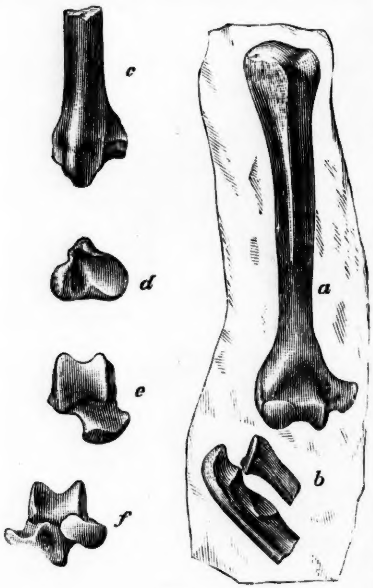

FIG. 2.

FIG. 2.—Bones of the specimens of *Plesiarctomys delicatissimus* Leidy, represented in Fig. 1. Fig. *a*, humerus, front view; *b*, proximal part of ulna and radius. Fig. *c*, distal part of tibia posterior side; *d*, same from below; *e*, astragalus from above; *f*, astragalus and calcaneum, distal ends. Original from Vol. IV, Report U. S. Geol. Survey Terrs.

The species from which most of the characters of the genus as above stated have been derived are the *P. delicatior* and *P. delicatissimus*. They further display the following general characters: The anterior limbs are relatively longer than in recent species of squirrels. The head of the radius is rounder, indicating an unusual power of rotation of the anterior limb. The pelvis is larger, being as long as the skull, and it is probable that the posterior limb is larger. These points indicate approximation to the cotemporary Mesodonta, or half lemurs.

No characters have yet been offered by which to distinguish the American species as representing a genus distinct from the *Plesiarcto-*

mys gervaisii of the French Eocene. Bravard briefly distinguishes the genus as distinct from Arctomys in the greater thickness of the angles of the molars, which thus become tubercles. Only the mandible and mandibular teeth of the *P. gervaisii* are known. It has been found in the Upper Eocene, near Perreal, Apt, France.

I have seen six species of this genus, of which two, *P. hians* Cope, and *P. undans* Marsh, belong to the Bridger beds only; one *P. leptodus* Cope, to the Washakie; one *P. buccatus* Cope, to the Wasatch and Wind river, and two, *P. delicatior* Leidy, and *P. delicatissimus*, Leidy, to all the Eocenes except the Washakie.

The following comparison of the *P. delicatissimus* with the *Sciurus niger*, or common gray squirrel, may be made. The pelvis is longer as compared with the bones of the fore leg. The humerus is longer as compared with the length of the ulna and radius. The species exceeds the *S. niger* in size, one-fourth linear.

It is then probable that the species of this, the oldest known genus of Rodentia, were arboreal, like the squirrels of the present geological period.

SYLLOPHODUS Cope.

This genus is much like *Theridomys* of the European Upper Eocene and Lower Miocene, and may be the same. The species were smaller than those of the last described, and are only known from lower jaws. These contain teeth which differ from those of Plesiarctomys in having cross-crests which are slightly connected at one side. They look like the unworn condition of Ischyromys, of which genus they may be the ancestor. Two species, *S. minimus* and *S. fraternus* have been described by Leidy. Both are from the Bridger horizon.

MIOCENE RODENTIA.

ISCHYROMYS Leidy.

The essential features are, dentition, I., $\frac{1}{1}$; C., $\frac{0}{0}$; M., $\frac{5}{4}$; the molars with two crescents on the inner side above, each of which gives rise to a cross-ridge to the outer margin. In the mandibular series the crests and crescent have a reversed relation. No cementum.

To the above characters given by Dr. Leidy, I have added the absence of postfrontal processes, and the superior position of the infraorbital foramen. Also that the pterygoid fossa is large, and

that its inner and outer plates are well developed, and subequal.

The bones of the limbs are generally similar to those of the Sciuridæ. In this family the genus Gymnoptychus nearly resembles Ischyromys in dental characters. But besides the important difference in the former and position of the infra-orbital foramen, Ischyromys has an excavated posterior palatal border.

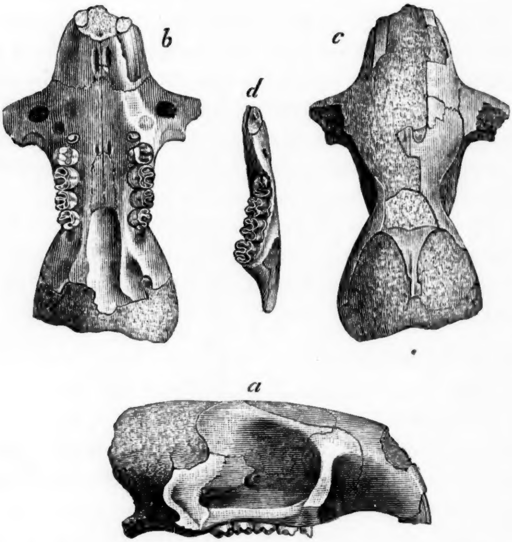

FIG. 3.—*Ischyromys typus* Leidy, natural size, from the White river beds of Colorado, original, from the Report U. S. Geol. Surv. Terrs. *a*, *b*, *c*, cranium; *d*, mandible from above.

Dr. Leidy remarks that this genus belongs to the family of the Sciuridæ. This is indicated by the dental characters; but in some other respects there is a greater divergence from the squirrels and marmots than is the case with the genus Gymnoptychus. Thus, the large *foramen infraorbitale anterius* occupies the elevated position at the origin of the zygomatic arch seen in the porcupines and cavies. There is no superciliary ridge nor post-orbital process as in most Sciuridæ, but the front is contracted between the orbits in the same manner as, but to a less degree than, in Fiber, and the Eocene Plesiarctomys Brav. Both the last named and Ischyromys present many points of resemblance to Pomel's tribe

of Protomyidæ, but differ from any of the genera he has included in it.

This family is thus defined by Pomel:[1] "Infraorbital foramen as large as in the Hystricidæ, and by the position of the angular apophysis of the mandible almost in the general plane of the horizontal ramus. The jugal bone, at least in those species where we have observed it, is very much enlarged at its anterior portion, and the orbit is almost superior."

These characters apply to Ischyromys, excepting as regards malar bone, which is principally unknown in the latter.

Another family, the Ischyromyidæ, has been proposed by E. R. Alston, for the reception of this genus, to which he thinks with me[2] Plesiarctomys (=Pseudotomus) should be referred. He thus defines the family:[3] "Dentition as in Sciuridæ; skull resembling Castoridæ, but with the infra-orbital opening large, a sagittal crest; no post-orbital processes; palate broad; basioccipital keeled."

Doubtless Ischyromys belongs to an extinct family, but which of the above names is available for it I do not yet know. I would characterize it as follows:

Dentition as in Sciuridæ, infraorbital foramen large, superior; pterygoid fossa large, with well-developed exterior as well as inferior walls; a sagittal crest.

The superior position of the infraorbital foramen and the well-developed pterygoid laminæ are characteristics found in the Muridæ.

But one species of this genus is known, the *Ischyromys typus* Leidy. The skull is as large as that of a prairie marmot. The limbs are comparatively small, so that the animal was not probably arboreal in its habits.

SCIURUS Linn. (true squirrels).

In this genus the molars are $\frac{5}{4}$ or $\frac{4}{4}$, the first superior small when present. The grinding surfaces of the crowns when unworn present in the superior series a single internal cusp, which is low and anteroposterior. From this there extend to the external border of the crown two low transverse ridges, whose exterior

[1] Catalogue Method. et Descr. de Vertebres Foss. de le Bass. de la Loire, 1853, p. 32.

[2] Annual Report U. S. Geol. Survey Terrs., 1873 (1874), p. 477.

[3] Proceed. Zool. Society London, 1876, p. 78.

terminations are somewhat enlarged. In the lower jaw the transverse ridges are not visible, and there is a low tubercule at each angle of the crown, between which there may be others on the border of the crown. Attrition gives the grinding surface of the latter a basin-like character. The *foramen infraorbitale* is a short, narrow fissure, situated in the inferior part of the maxillary bone in front of its tooth-bearing portion, but descending to the level of the alveolar border.

The well-known characters of this genus are found in the mandibles of species which I obtained from the White River Miocene beds of Colorado and the John Day of Oregon. The teeth display the subquadrate form of this genus, without any tendency to the transverse enlargement seen in Arctomys, Cynomys, and Spermophilus. Two of the species, *S. vortmani* Cope and *S. relictus* Cope are as large as our gray and red squirrels, respectively, and the third, *S. ballovianus* Cope, is about the size of the *Tamias quadrivitatus* or Western chip-munk. The *S. relictus* is from the White River formation, and the two other species from the John Day.

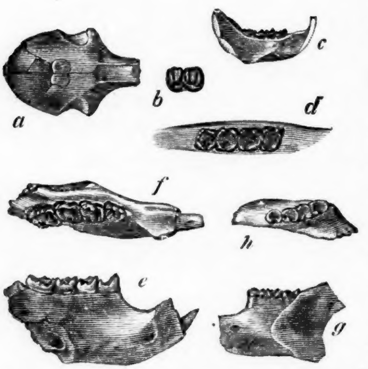

FIG. 4.—Skull and jaws of species of Sciurus; original, from Vol. IV Report U. S. Geolog. Surv. Terrs. Figs. *a–d*, *S. ballovianus*; *b* and *d*, superior and inferior molar teeth enlarged. Figs. *e–f*, *S. relictus*, enlarged one-half. *g–h*, *S. vortmani*, natural size.

GYMNOPTYCHUS Cope.

In dentition this genus is much like Ischyromys. There are only four superior molars.

As compared with the existing genera of squirrels, it differs in the structure of the molar teeth. The arrangement of the tubercles and crests is more complex than in any of them, excepting Pteromys. Thus in all of them there is but one internal crescent of the superior molars, and but two or three cross-crests; while in the inferior molars the arrangement is unlike that of the superior teeth, the cross-crests being marginal only. In Pteromys (F. Cuv.) the transverse valleys of the inferior series of Gymnopty-

chus are represented by numerous isolated fossettes. The structure of the molars in the fossil genus is exactly like that which I have described as found in Eumys, extending even to the details. This is curious, as that genus is probably a Myomorph.

The protrusion of the posterior extremity of the alveolor sheath of the inferior incisor on the outer side of the ascending ramus is not exhibited by the North American Sciuridæ which I have examined, nor by any of the extinct genera herein described, excepting Castor and the Geomyidæ. It is seen in a lesser degree in the house and wood mice, the jumping mouse and meadow mouse, all Muridæ.

FIG. 5.—*a–d*, *Gymnoptychus minutus* Cope, from the White River bed of Colorado. *a*, natural size; *b–d*, enlarged, *e*, lower jaw of *Gymnoptychus trilophus* Cope, from above, enlarged; same locality. Original.

Two species of this genus are certainly known. They belong to the White River horizon of Colorado. They differ, so far as known, chiefly in size, and in the proportions of the inferior premolar tooth. See Fig. 5.

MENISCOMYS Cope.

This genus is readily distinguished from all the others here treated of, by the complexity of the structure of its molar teeth, and the curious resemblances that some of them present to the molars of the hoofed mammalia. They are without enamel inflections, and the triturating surface exhibits two external and one internal crescentic sections of the investing enamel. On the second superior molar there are three external crescents, and the first molar is simply conic. Between the inner and external crescents there are the curved edges of enamel plates directed obliquely and transversely. The grinding surfaces of the inferior molars display, in the unworn condition, curved transverse crests, connected longitudinally on the median line; on wearing, the lateral emarginations of the enamel become shallower, disappearing from the inner side, but remaining on the outer. Incisor teeth not grooved. *Foramen infraorbitale anterius* small inferior,

and near the orbit. Postorbital processes; no sagittal crest.

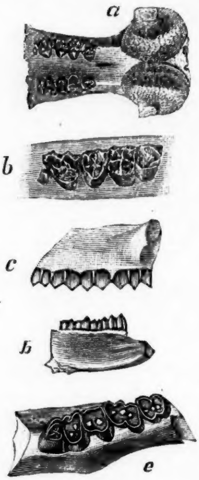

FIG. 6.—Cranium, jaws and teeth of *Meniscomys hippodus* Cope, from the John Day bed of Oregon; natural size and enlarged.

The characters of the dentition of this genus resembles those of the genus Pteromys, which includes the large flying squirrels of Asia and the Malaysian archipelago, to which region they are confined. The superior molars differ from those of Pteromys in wanting all re-entrant enamel inflection.

The general characters of the skeleton are unknown. A femur is rather slender, and a tibia rather elongate, showing that the limbs are not short.

Four species of this genus are known to me, all from the John Day Miocene of Oregon. They differ considerably in the details of the structure of the molar teeth. Those of the *Meniscomys hippodus* are more prismatic than those of the other species, and the external face is not inflected at the grinding surface as in them. Nevertheless the molars have short roots. The arrangement of the crests of the crown of the superior molars is a good deal like that to be seen in the molars of some of the later three-toed horses, if the cementum be removed. (Fig. 6.)

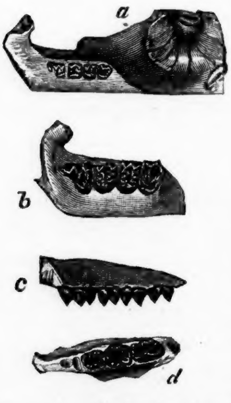

FIG. 7. — *Meniscomys cavatus* Cope, part of cranium and lower jaw of one individual from the John Day river, Oregon; nat. size and enlarged. Original.

In the *M. cavatus* Cope (Fig. 7), the constitution of the superior molars is more complex, while that of the inferior molars is more simple. The bulla of the ear is set with simple transverse septa within, while in the *M. hippodus* their internal face has a reticulate structure like tripe. The superior molars of the *M. liolophus* Cope (Fig. 8, *a*, *b*) have their crests and cusps unwrinkled. In the *M. nitens* Marsh, they are complex and much wrinkled, while the lower molars

are most complex with reticulate ridges. (Fig. 8, *c*.)

There is a suggestive resemblance between the forms of the molar teeth of the *Meniscomys hippodus* and those of the *Haplodontia rufa* now living in Oregon. The two genera have doubtless had a common origin, but the present differences are considerable. Thus the Haplodontia has an extended osseous cavum tympani, which does not exist in Meniscomys.

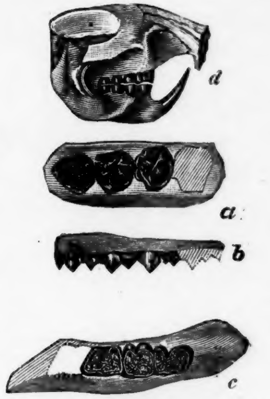

FIG. 8.—*a–b*, superior molars of *Meniscomys liolophus*, enlarged. *c*, inferior molars of *M. nitens* from above, enlarged. *d*, skull of the *M. hippodus*, nat. size. Original; from the John Day river, Oregon.

CASTOR Linn.

The beaver is the largest rodent of the northern hemisphere, and has the widest distribution. It was preceded in the Miocene period by a

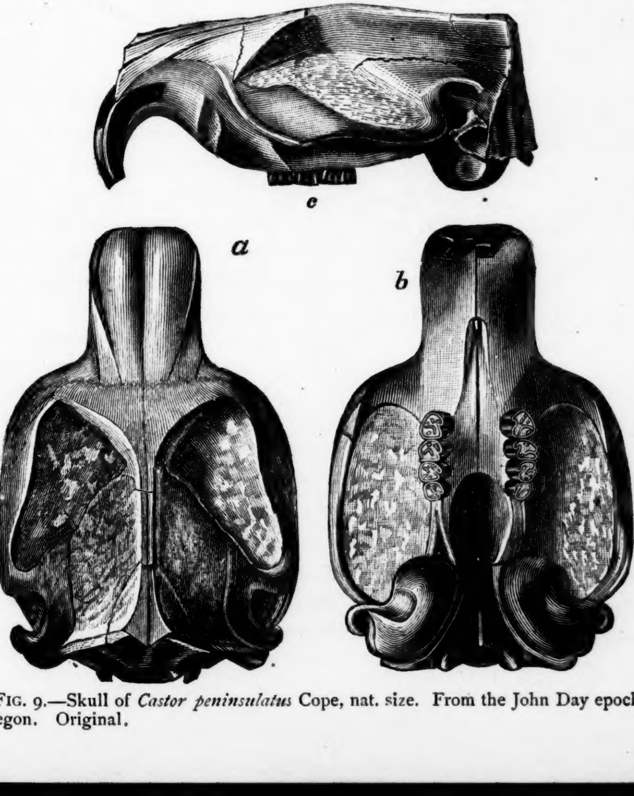

FIG. 9.—Skull of *Castor peninsulatus* Cope, nat. size. From the John Day epoch, Oregon. Original.

number of species in both the eastern and western continents, of inferior size and more restricted distribution. The greater number of these belong, I believe, to the same genus as the *Castor fiber*, though they have been separated under the name of Steneofiber Geoffr. There is no essential difference in the dentition, and it is probable that the extinct species had the peculiar flat tail of the modern beaver. The caudal vertebræ of the *C. pansus*, from Nebraska, have exactly the character of those of the beaver.

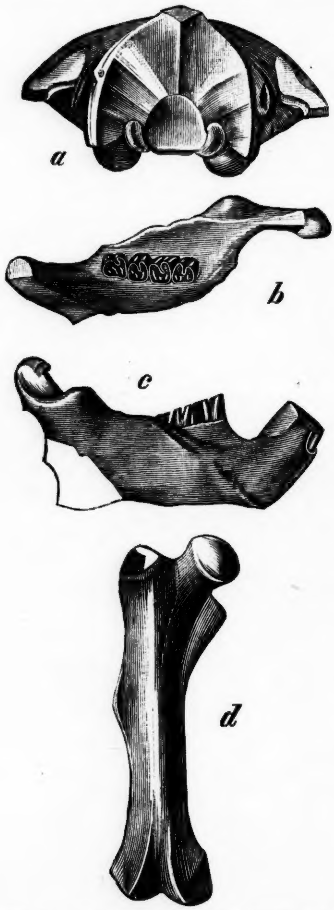

FIG. 10.—Skull and bones of *Castor peninsulatus* Cope, represented in Fig. 9. *a*, occipital view; *b*, *c*, right ramus of mandible; *d*, right femur. Natural size.

The family of the Castoridæ differs from the Sciuridæ in the absence of postorbital angles or processes, and the presence of a prolonged tube of the meatus auditorius externus. In both of these points it agrees with the Haplodontiidæ, a family which Mr. Alston has distinguished from the Castoridæ on various grounds. I do not think any of his characters are tenable, excepting that drawn from the form of the mandible, which is expressed thus in Mr. Alston's diagnosis: "angular portion of mandible much twisted." This character will be better described as follows: Angle of mandible with a transverse edge due to inflection on the one hand, and production into an apex externally; the inflection bounding a large interno-posterior fossa.

The *Haplodonta rufa* is a curious burrowing rodent found in the Cascade mountains of Oregon, and is known as showtl or sewellel. It has no tail.

The longest known species of this genus is the *C. viciacensis*, which is common in the Miocenes in several parts of Europe. In North America the *C. nebrascensis* Leidy, is stated by Hayden and Leidy to be found in the White River formation. It is of about the same dimensions as the European species. So are the *C. peninsulatus* Cope, from the John Day River epoch of Oregon, and the *C. pansus* of the Loup Fork horizon of New Mexico and Nebraska (see Fig. 11). The smallest species is the *C. gradatus* Cope, a contemporary of the *C. peninsulatus* in Oregon. None of these species are nearly so large as the recent beaver.

Fig. 11.—*Castor pansus* Cope, Loup Fork epoch; *a*, *b*, from New Mexico; *c*, caudal vertebra from Nebraska. Nat size. Original.

EUCASTOR Allen.

Besides the preceding, there are some other forms of beavers in the late Tertiaries of North America and Europe.

The *Castor tortus* was described by Leidy from the Loup Fork formation of Nebraska. He coined the subgeneric name Eucastor for it without corresponding definition. In his monograph of the Castoridæ, J. A. Allen referred this species[1] to a genus distinct from Castor, and defined it, using for it Leidy's name Eucastor. This genus appears to me to be valid. The three genera of Castoridæ will then be defined as follows:

Molars and premolars with one inner and two or three outer folds . . . . *Castor*.
" Inferior premolar and third superior molar elongate, with four enamel folds; the rest with only two " . . . . *Diobroticus*.
Superior premolar enlarged, with one inner fold; inferior molars small, with two lakes . . . . *Eucastor*.

[1] Monographs of North American Rodentia, Coues and Allen, U. S. Geol. Surv. Terrs., 1877, XI, p. 450.

The *Eucastor tortus* was larger than any of the extinct species of Castor, but was considerably smaller than the beaver. The *Diobroticus trogontherium* of Europe was a still larger species, one-fifth larger than the beaver in dimensions.

MYLAGAULUS Cope.

The reduction of the posterior molars, seen in Eucastor, is carried to a still higher degree in this genus. The last or fourth molar has disappeared, and the indications from the specimens are, that the third was early shed. The second is a small tooth, while the first is enormous, and performed the greater part of the function of mastication.

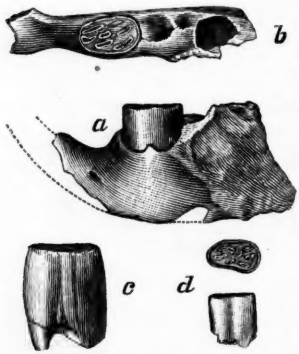

FIG. 12.—*a, b, c, Mylagaulus monodon* Cope, lower jaw and a separate tooth, natural size; *d, M. sesquipedalis*, first inferior molar, nat. size. Original. From the Loup Fork epoch of Nebraska.

The characters of the genus are: Inferior molars three, rootless; the first much larger than the others. Enamel inclosing the first molar not inflected; but numerous fossettes on the grinding surface of the crown, whose long diameter is anteroposterior.

The only lower jaw of a species of this genus in my possession presents a small part of the base of the angle and of the coronoid process. These parts are so nearly in the plane of the incisive alveolus as to lead to the belief that the genus Mylagaulus belongs to the sub-order Sciuromorpha. The rootless teeth with deep enamel fossettes approximates it to the Castoridæ, but it appears to me that a new family group must be established for its reception. Such characters are the presence of only three inferior molars, and the entire independence of the enamel fossettes of the external sheathing enamel. It is worthy of investigation whether the *Hystrix refossa* Gerv. has any relation to this family.

Two species of this genus are known: a larger *M. monodon* Cope, and a smaller, *M. sesquipedalis* Cope. Both are from the Loup Fork epoch of Nebraska. The former was about the size of the wood-chuck (*Arctomys monax*), to judge by the dimensions of its lower jaw. It is larger than the American *M. sesquipedalis*, and has a different arrangement of the enamel fossettes. In that species, in-

stead of being in three parallel lines, the middle line is only represented by its extremities. At the middle of the crown the fossettes of the internal line are incurved so as to be nearly in contact with the fossettes of the external line.

HELISCOMYS Cope.

Inferior molars four-rooted, the crowns supporting four cusps in transverse pairs. A broad ledge or cingulum projecting on the external side from base of the cusps. The inferior incisor compressed, not grooved, and with the enamel, without sculpture.

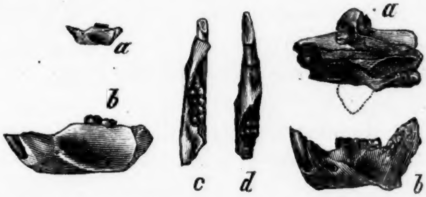

FIG. 13.—*a–d*, lower jaws of *Heliscomys vetus* Cope; *a*, natural size; *b, c, d*, enlarged; *e, f, Eumys elegans* Leidy, natural size; *e*, cranium from above; *f*, left ramus of lower jaw, external side. All from the White River epoch of Colorado. Original.

This genus is only represented by a small number of specimens, which are mandibular rami exclusively. Its special affinities therefore cannot be ascertained, and even its general position remains somewhat doubtful. There is some probability, however, that it belongs to the Myomorpha, as the type of dentition is much more like that of the genera of that group than those of the Sciuromorpha. To the Hystricomorpha it does not belong.

As compared with known genera of Myomorpha, it is at once separated from many of them by the presence of a premolar tooth. Among recent genera of this sub-order, Sminthus possesses this tooth in both jaws, and Meriones in the upper jaw only. It is present in both jaws in the Sciuromorpha generally. The tubercles of the teeth resemble those of the Muridæ, but their disposition is unlike that of any existing North American genus. A remote approximation to it is seen in the genus Syllophodus of the Bridger Eocene formation, where there are four subquadrate molars with tubercles; but the latter form two transverse crests, with an additional small intermediate tubercle, and the wide cingulum is absent.

But one species of Heliscomys is known, the *H. vetus*, from the White River epoch of Colorado. It is not larger than the domestic mouse (*Mus musculus*).

(To be continued.)

EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

—— With 1883 the AMERICAN NATURALIST commences the seventeenth year of its existence. It enters this period with a larger constituency of readers and contributors than it has had at any time in the past. It is, however, not only on the numbers but on the quality of its patrons that the management feels disposed to congratulate itself. It appears to be the most favored medium of publication of the naturalists and biologists of the United States, when they wish to bring the results of their investigations before the general public in a more or less popular form. We hope to continue to deserve the favors of our friends, and present them this month with solid evidence of our intentions in this respect.

The present number contains thirty pages more than the standard number heretofore published, and it is intended that this increased amount shall be permanent. We add two new departments, those of physiology and psychology, which supply a need we have long felt. These give us a total of ten departments, the greater number of which are separately sub-edited by able scientific men. It is especially our aim to preserve the well-known national character of the NATURALIST. Our editors represent different regions; one resides in Boston, one in Providence, three in Philadelphia, two in Washington, one in Ann Arbor, Michigan, and one in Iowa. For our new departments we hope to secure the services of representative men in other sections.

An especial feature of the NATURALIST is the preference which it gives to American work and workers. *It is the only magazine in the world to-day which keeps its readers en rapport with the work of Americans in the field of the natural sciences.* To do this more perfectly in the future will be the object of its managers and editors.

—— The zoölogy of the future is to be more and more the study of living beings, rather than of museum-preserved skin and bones. The best schools in Europe for the zoölogist are the sea-side laboratories at Naples, at Roscoff and Banyul-sur-le-mer. In England and this country museum-trained men have obtained the best results and have most advanced biology by deep-sea dredging and marine exploration, for the sea has been the source of all life. It is refreshing to read of Haeckel's journey to Ceylon. Like an old-

time naturalist he goes into raptures over the beauties and wonders of tropical scenery, the luxuriant equatorial vegetation, the interesting human races of Ceylon—all this, while pursuing his special researches. It is a refreshing sign of the times that as histologists, embryologists and anatomists, we can do without museums, elaborate and costly piles of brick and mortar, but can by the ever resounding sea, the flowing river, the quiet lake, commune with living nature. The palæontologist even, leaving his boxes of bones, his drawers of disjointed skeletons and fossil shells, while digging in the cemeteries of departed life forms, gets his meed of inspiration, as ennobling in its way as Gray's "Elegy written in a Country Churchyard."

There is little doubt but that the zoölogical student, after a year or more spent in Germany, returns with new ideas, new fields of research and new methods. Incomparably the best school, however, for the advanced American student, would be a year or more spent at the Zoölogical Laboratory at Naples. It is hoped that the means may be found in the United States to engage a table and send a promising working naturalist to Naples.

In this connection the proposed permanent zoölogical laboratory in connection with the work of the U. S. Fish Commission, at Wood's Holl, is of interest. It is designed to erect a permanent building, with work-rooms, large tanks and all the apparatus for studying the habits and development of marine animals, from sharks and the food-fishes down to the minutest forms of life. A steamer of 1000 tons is now building especially designed for deep-sea dredging in the Atlantic ocean. She is to be fitted with electric lights which can be lowered 500 fathoms, so as to light up the sea-bottom. With these appliances and means for investigation, it only remains to furnish the men who can make the best use of such grand facilities, and produce work like that which has emanated from Naples and Roscoff.

—— The National Academy of Sciences has, at present, ninety-six members and four honorary members. The possible number of members is one hundred. There are nine foreign associates. The principal localities which furnish the members and honorary members are as follows: Washington, 15; Philadelphia, 13; Boston and neighborhood, 13; New York and neighborhood, 12; New Haven, 12; San Francisco and neighborhood, 4; Princeton, 3; Baltimore and St. Louis each 2. The condition of election to the National Academy is original work done, as in the academies of sciences of Europe. A much more rigid scrutiny is now given to the claims of candidates than was the case at the time of the organization of the Academy. No person can now be elected to membership who cannot show a record of original work of a high standard. A few of our ablest scientists are, however, not yet members, but their election is only a question of time. By the

death of Professor W. B. Rogers the office of president is now vacant. The candidates for the position most spoken of, are Professor J. D. Dana, Professor F. A. P. Barnard and Professor James Hall.

—— The numbers of the AMERICAN NATURALIST for 1882 were issued on the following dates: January, Dec. 30, 1881; February, January 25, 1882; March, Feb. 24, 1882; April, March, 22, 1882; May, April 24, 1882; June, May 20, 1882; July, June 22, 1882; August, July 28, 1882; September, Aug. 24, 1882; October, Sept. 28, 1882; November, Oct. 28, 1882; December, Dec. 2, 1882.

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RECENT LITERATURE.

A NEW EDITION OF SACHS' BOTANY.[1] It is now more than seven years since the English-speaking and reading botanists were laid under great obligations to Macmillan & Co., for bringing out the translation of the third edition of Sachs' Lehrbuch, made by Bennett and Dyer. During this period it is safe to say that no single book on morphological and physiological botany has been more studied and consulted by advanced students, and it is not too much to affirm that few books have ever exerted a more beneficial effect upon a science, than it has in England and America. We have now a new English edition of this important work, based upon the fourth German edition of the Lehrbuch, but with many additions, corrections and modifications by Dr. Vines, who, for some years has been well known as a careful student and investigator.

It would be impossible within the limits of an ordinary review to notice the peculiarities of the new edition, containing as it does over one hundred pages more matter than the old one. New paragraphs and sections are common throughout the volume, those by Dr. Vines being generally distinguished by being enclosed in brackets. The chapter on Thallophytes, although no longer novel, will still be of interest on account of the new notes which occur here and there in the body of the book, and especially in the appendix. We note with pleasure the remark [Appendix, p. 955], that as the nuclei of the coalescing myxoamœbæ remain distinct, "the plasmodium can no longer be regarded as the equivalent of a zygospore, and the position of the Myxomycetes among the Zygomycetes is untenable." This relegates the Myxomycetes to the Protophytes, where they were first placed by Fischer, and subsequently by us in our "Botany."[2]

[1] *Text-Book of Botany, Morphological and Physiological.* By JULIUS SACHS, Professor of Botany in the University of Wurzburg. Edited, with an Appendix, by SIDNEY H. VINES, M. A., D. Sc., F. L. S., Fellow and Lecturer of Christ College, Cambridge. Second Edition. Clarendon Press, Oxford, 1882. New York: Macmillan & Co.

[2] *Botany for High Schools and Colleges*, New York, 1880.

The proposition is made [Appendix, p. 956], to unite the Zygosporeæ and the Oosporeæ, because of the apparent extension of the Fucoideæ and Siphoneæ into these two groups. Another suggestive paragraph on p. 956, gives a short account of DeBary's views respecting the affinities of the groups of the higher Fungi, as expressed in his Beiträge (No. 4, 1881). After giving other apparent relationship, it is stated that "the Uredineæ form one of the more highly developed groups of the Ascomycetous series," exactly the position which we have assigned them. (Botany, p. 310, *et seq.*)

The mechanical execution of the volume is similar to that of the first edition, there being the same clear type, and excellently printed figures. Of the latter there are thirty-one more than in the previous edition. To say that there are no errors or inconsistencies of translation or editing, would be to claim a perfection impossible in so large a volume. The work has been so well done that every botanist in this country may well thank the editor for his labor. However, a few things might have been avoided; for example, on p. 62, the term "metabolism" is used instead of "metastasis," and it is there stated that it "will be adopted in the following pages," but upon turning to page 703, one finds "Assimilation and Metastasis" as in the old edition. There is, moreover, a great difficulty in distinguishing between the foot-notes added by the editors of the first and second editions. These, however, are but small blemishes in a great and valuable work.—*C. E. B.*

Disposition of the Cervical Vertebræ of Chelonians.[1]—M. Vaillant has here given to the world the results of his studies of the cervical vertebræ of nearly fifty species of Chelonians, including *Emys ornata, Testudo sulcata, Cinosternum pennsylvanicum, Thalassochelys caretta, Chelodina longicollis, Sternothærus castaneus,* and *Trionyx javanicus,* and thus ranging through all the principal groups of the order.

This portion of the skeleton has heretofore been but little studied, and our author reviews all previous notices of it in the most thorough manner. The variations in structure are greater than would be expected in so homogeneous an order, yet are correlated with the habits of the various species, dependant in all cases upon their mobile neck for the power of seizing their food. Notwithstanding this diversity, M. Vaillant states that the eight cervical vertebræ can always be readily distinguished from those of other parts of the vertebral column.

The greater portion of the article is taken up by technical description and comparison of these bones in the various species examined, but a resume, with a diagrammatic tableau, brings

[1] *Memoirs sur la Disposition des Vertebres Cervicales chez les Chelonians.* Par M. Leon Vaillant. (Présenté a l'Academie des Sciences le 15 Nov. 1880, Annales Sci. Nat. Zool., Art. No. 7.)

clearly out the principal points of structure. Procœlian, opisthocœlian, amphicœlian and amphicyrtian or double-convex vertebræ occur in this region, the two former in greatest number. Amphircyrtian double convex vertebræ are often wanting; when there are two, one is always the eighth, but the other varies in position; as do also the single amphircyrtian double-convex vertebræ of other species.

Ginglymoid articulations vary also from three to none, but their position is always between the hindermost vertebræ. These ginglymoid articulations have direct relation to the mode in which the neck is retracted, since they permit only movements of flexion and extension; thus it is easy to comprehend their absence among the pleurodercs, in which the retraction of the neck is performed by a deduction. The marine turtles have only one ginglymoid articulation, and thus in this respect stand between the pleuroderes and the true cryptoderes, which have two or three.

The Trionychidæ have only one or two ginglymoid articulations, but their fewness is more than counter-balanced by the perfect supplementary ginglymus presented by the dorso-cervical articulation. From the possession of this peculiarity the Trionychidæ constitute a type apart from other Chelonians.

The variations in the double-convex vertebræ in forms, evidently nearly related, renders their physiological function less easy to determine, yet it is evident they play an important part in the retraction of the neck. The marine turtles possess but one of these vertebræ, and this has but slight convexities.

The Chelydras, Cinosternes and Staurotypes have also but one, with convexities more prominent than in the marine turtles (Thalassians), and in these tortoises, especially the first group, the retraction of the neck is incomplete, although more perfect than in the marine turtles. The true cryptoderes, Testudo, Emys, Cistudo, Terrapene, etc., have two such vertebræ; while the pleuroderes with long necks have two; those with shorter necks one. M. Vaillant does not venture to assign a reason for the variable position occupied by these double-convex vertebræ, since it is not constant even in the same genus.

M. Vaillant promises to follow up his valuable researches upon the hard parts by a study of the actual mode of articulation and of the muscles. Not only is the mode of articulation very variable in the different species, but even in the same individual, and it is difficult to bring some of them under the generally admitted varieties.

In most cases the atlas is distinct from the odontoid process, which is united by a close amphiarthrosis to the second vertebra, and movements are effected by articulations which unite it to the three portions of the atlas, which in very old individuals is a single bone. In most pleuroderes the odontoid apophysis is firmly

united to the atlas, and movement is limited to that possible between the adjoining facets of the odontoid and atlas, but in *Elseya latisternum* the odontoid process is distinct. On the other hand, *Cycloderma aubryi* among the Trionychidæ has these parts united to that any extended movement seems impossible.

M. Vaillant does not consider the retraction or non-retraction of the neck a leading character, and prefers to keep the usual classification into the three great families of Cheloniida, Trionychidæ, and Testudinidæ. The first of these includes the Thalassians and the Chelodinæ (pleuroderes), the second the Trionychidæ only; the third the Chelydina (pleuroderes) and Chersemydina, which last group embraces the incompletely cryptodere Chelydreæ and the truly cryptodere Testudineæ.

Whatever difference of opinion there may be upon the value of certain characters in classification, we will not deny the force of M. Vaillant's argument, which is as follows:

"When we consider that animals as intimately related as are *Testudo pusilla* and *Pyxis arachnoides* present really important differences in the constitution of the cervical part of the back bone, we cannot but place a great distinction between genera established from the elements at the disposal of the palæontologist and those established by the more complete study of the whole structure of living animals."

ALLEN'S HUMAN ANATOMY.[1]—The object of the author of this work is to present the facts of human anatomy in the manner best suited to the requirements of the student and practitioner of medicine. It is, in fact, intended to be a physician's human anatomy, not one for the use of the scientist or the surgeon, for one or the other of whom most works upon anatomy have been written. As surgical and general medical practice are not separated from each other in this country to the same extent that they are in Europe, the author believes rightly that there is room for a work which shall accurately and concisely express the present state of anatomical science, including every application thereof needed by the physician.

The form and construction of the human body, the variations in the condition of the various organs within the limits of health, the relations of the parts to each other, both topographically and clinically; the uses of the organs, and the nature and general behavior of morbid processes with the manner in which they are modified by locality, should all be known to the physician, and will obtain ample treatment in this work. Aware that some of these desiderata trench upon physiology, Dr. Allen engages only to treat of them from an anatomical point of view. Those scientists who are not physicians will be pleased to find that the work

[1] A System of Human Anatomy, including its medical and surgical relations. By Harrison Allen, M.D. Philadelphia: Henry C. Lea's Son & Co., 1882.

contains an elaborate description of the tissues; an account of the normal development of the body, and a section upon monstrosities; while not the least useful part to those engaged in the medical profession will be that devoted to the method of conducting post-mortem examinations, and to medico-legal matters generally.

The work will appear in six sections, two of which, that on Histology, by E. O. Shakespeare, M.D., and that on Bones and joints, by Dr. Allen, are already issued.

The other sections are as follows: III. Muscles and fasciæ; IV. Arteries, veins and lymphatics; V. Nervous system; VI. Organs of sense, of digestion, and genito-urinary organs. The section upon histology contains twelve delicately executed plates and numerous woodcuts, and treats fully and clearly upon the lymph, blood, connective tissue, epithelium, cartilage, bone, muscle, nervous tissue, etc.

In the second section, which is illustrated with thirty plates, an innovation is introduced which ought to be extensively followed. Each bone figured is drawn to a scale sufficiently large to enable the names of all the parts, processes, foramina, etc., to be printed upon or around them, thus obviating the waste of time and lack of precision caused by literal or numbered references. Nothing more complete than the figures and descriptions given of both bones and joints can well be desired, and if the rest of the work is equal to the parts before us, Dr. Allen may be congratulated upon having to a great extent attained the goal aimed at.

The greatest drawback to the work is its high price; small enough, probably, to the well-established physician, but very large to the student and commencing practitioner, to both of whom its acquisition would be a boon.

Thomas's Report on the Noxious and Beneficial Insects of Illinois.[1]—This report is principally composed of that of D. W. Coquillet, on the insects of Northern Illinois, and of that of Professor G. H. French. The former notes the occurrence in destructive numbers, in the year 1881, of the corn or boll worm (*Heliothis armigera*), the imported currant worm (*Nematus ventricosus*), the gooseberry worm, and the larva of *Eupilhecia interrupto-fasciata* Packard, the latter of which devours the interior of the currant berry. Descriptions of the principal injurious insects and their methods of destruction, with an account of their insect enemies, and mention of such remedies as have been found useful, render the report valuable to all who are interested in agriculture. The most effectual method to prevent the moth of the yellow canlœr worm (*Hibernia hiliaris*) from depositing its eggs upon apple, elm or other trees, is stated to be, to place tarred paper, such as is used in buildings, around the trunk of the tree to

[1] Eleventh Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. Springfield, 1882.

be protected, and then to apply more tar. Mr. Coquillet has proved that the army worm produces three broods in a season, and hibernates in the larva state. Some army worms live as cut worms, never migrating, while others migrate in large armies from field to field, and the writer argues cogently that the migrating worms are a distinct race, the progeny of moths, the caterpillars of which lived in marshes, and acquired the habit of migrating before the annual overflows; while the sedentary worms are bred from moths that for many generations have lived in the same locality. Professor French describes a new wheat-straw worm (*Isosoma allynii*), and gives a most interesting history of the depredations of the boll worms.

THE GEOLOGY OF PHILADELPHIA COUNTY, ETC.[1]—This is among the latest contributions of the Geological Survey and is introduced by a preface of sixteen pages (entitled a letter of transmittal) by Professor Lesley and ninety-four pages of Mr. Hall's report. The first fourteen pages of this latter contain the general remarks of Mr. Hall, with a table of the order of the formations as he conceives them to be, and a condensed summary of his reasons for believing the South Valley Hill rocks and the Philadelphia and Chestnut Hill schists superior to the Chester Valley limestone. The succeeding thirty-three pages are devoted to general descriptions of the formations and contain numerous sketches, small maps and sections. Following these are forty-three pages of township geology, which complete Mr. Hall's part of the volume. The remaining forty-three pages are devoted to the chemical work of Dr. Genth and Mr. F. A. Genth, Jr.

This work is an exceedingly important one because it brings to a head in the work of the Geological Survey of Pennsylvania a difference of theory which has already come to the surface in other parts of this country and indeed in Europe as to the relative ages of various groups of Palæozoic and Eozoic rocks. Professor Lesley in his introduction pays a justly merited tribute to the sagacity of Professor John F. Frazer, of the first Geological Survey of Pennsylvania.

He states, on what ground does not appear in the volume, that the serpentine which Mr. Hall traces to Bryn Mawr, does not continue its south-westwardly course through Delaware and Chester counties, and asserts, that "we can accept the palæozoic age of the Philadelphia rocks with a moderately reserved confidence."

Mr. Hall's argument may be condensed somewhat as follows:

1. "The Philadelphia, Manayunk and Chestnut Hill beds or South Valley Hill, which is equivalent to part of them, cannot be older than the Laurentian." (Roger's third Belt). This will be generally admitted.

[1] *The Geology of Philadelphia county and the southern part of Montgomery and Bucks*, by CHARLES E. HALL; with analyses of rocks by F. A. Genth and F. A. Genth, Jr. Second Geological Survey of Pennsylvania, C. 6.

2. "It is clear that the Potsdam sandstone was deposited on the third belt."

This is not in conformity with numberless observations made in Adams, York, Lancaster and Chester counties as may be seen by consulting the maps and text of reports, C, CC, and CCC and of Chester county when it is published, as well as notes made by Dr. Frazer in the company of Mr. Hall at Harper's Ferry.

3. "But it is equally clear that the mica schists and gneisses are not found between the Primal and the rocks of the third belt." This statement is inconsistent with a whole host of observations on the South mountain and in the counties named above as well as in Cumberland and Franklin.

4. "If the mica schists were older than the Potsdam, they must have been deposited up to a geographical line." Not if there was a fault along the South Valley hill which diverged to the south slightly before reaching the eastern extremity of that valley.

5. "Even supposing a fault * * there would still be some remnants of these rocks in their normal position * * and fragments * * entombed in the Potsdam," &c.

As to the first, abundant demonstration of it exists in the counties above named, and that the second proposition is in accordance with Mr. Hall's observations is clear from the fact, that out of six specimens of his Potsdam or Edge Hill rock sent to the laboratory for analysis, four were named by Dr. Genth and his son "hydro-mica schist;" which proves an abundance of that material in the rock.

Space will not here permit a presentation of the reasons for the opposite view, *i. e.*, that the South Valley Hill rocks belong *below* the limestone. This one consideration may be, however, presented that he who can, may accommodate it to Mr. Hall's theory.

In at least two places in Chester county limited areas of Laurentian rocks are observed to be in contact with the South Valley Hill schists (on this point Mr. Hall and Dr. Frazer are in accord). One of these areas, near West Chester, is completely surrounded by them. The other forms a narrow tongue or peninsula in contact with them on three sides. Yet there is not a sign of any of the thousands of feet of the Huronian, Potsdam or Limestone which ought to appear between them, according to Mr. Hall's view.

The color scale on the large geological map which accompanies Mr. Hall's report, seems to the stranger not to agree with the color as used on the map. On the former the intermediate Manayunk belt is designated by dark red, whereas on the map this color seems to be given to the northerly Chestnut Hill group, and *vice versa*.

The last forty pages contain the report of Dr. Genth on the dolerites, mica schists, gneisses, granites and other rocks of the district, and constitutes a very valuable leaf in the still small book of chemical lithology.—*P. F.*

JACKSON'S VEGETABLE TECHNOLOGY.[1]—The purpose of this work is to supply in compact form, references to the many botanical papers and books of economic interest, and which, in many cases, were so published as not to be catalogued in the ordinary book lists. As stated in the title page, the book is founded upon a catalogue of works on applied botany, prepared by Mr. G. J. Symons. To that list large additions and many corrections and modifications were made. Books or papers of purely local value were stricken out, as were also those on silk and cochineal culture, as well as those relating to the vine, the latter " simply on the ground of its enormous extent."

The plan of the work is to give first an author's catalogue of books, that is, the books, papers, etc., are arranged alphabetically by the author's names. The place and date of publication are given in each case, along with the full title. A catalogue of serials, and one of anonymous publications follow, the first notable for its shortness. No serial is entered for the United States.

The index of subjects fills about one hundred pages, and is sufficiently classified as to enable one to readily find any book or paper in the author's catalogue. The volume cannot fail to be of great use to librarians and others who wish to know the extent of the literature of the department of botany of which it treats.—*C. E. B.*

RECENT BOOKS AND PAMPHLETS.—Ext. Note sur l'Osteologie des Mosasauridæ. Par M. L. Dollo. Ext. du Bulletin du Musée Royal, d'Histoire Naturelle de Belgique. Tome I, 1882. From the author.

Synopsis of the Classification of the Animal Kingdom, by H. Alleyne Nicholson. Messrs. Blackwood & Co., Edinburgh and London, 1882. From the author.

The Quarterly Journal of the Boston Zoological Society. Vol. I. October, 1882. No. 4. From the society.

Prospectus of the second edition of the American Palæozoic Fossils. By S. A. Miller. From the author.

The Geological Record for 1878, with supplements for 1874–1877. Edited by Wm. Whitaker and W. H. Dalton. London, 1882. From the editors.

Sitzungberichte der Gesellschaft zur Beforderung der gesammten Naturwissenschaften zu Marburg, 1880 and 1881. From the society.

Etude Carcinologique sur les genres Pemphix, Glyphea et Araeosternus. Par T. C. Winkler. Ext. des Archives du Musée Teyler. T. I, sér. II, par. II. Haarlem, 1882. From the author.

Bulletin of the American Museum of Natural History. Central Park, New York. Vol. I, No. 3. On the Fauna of the Lower Carboniferous Limestone of Spergen Hill, Indiana, with a revision of the descriptions of its fossils hitherto published, and illustrations of the species from the original type series. By R. P. Whitfield, From the author.

Tryon's Manual of Conchology. Von W. Kobelt. Diagnosen neuer Arten (Helices). By the same. From the author.

Notes on some of the Tertiary Neuroptera of Florissant, Col., and Green river, Wyoming Territory. By S. H. Scudder. From the author.

[1] *Vegetable Technology.* A contribution towards a bibliography of economic Botany, with a comprehensive subject-index. By Benjamin Daydon Jackson, Secretaryof the Linnean Society. Founded upon the collections of George James Symons, F. R. S. London : Published for the Index Society. Dulan & Co. 1882.

Annual Report of the American Museum of Natural History, Central Park, N. Y. Feb. 15, 1882.

A sketch of the progress of American mineralogy, an address delivered before the Amer. Assoc. for the Adv. cf Science, at Montreal, Aug. 25, 1882, by Professor Geo. J. Brush, president. Salem. From the author.

On the Cranium of a new species of Hyperodon from the Australian seas. By W. H. Flower. From the Proc. Zool. Soc. of London, May, 1882. From the author.

An die Mitarbeiter und Freunde des "Kosmos." By Professor Dr. B. Vetter. A notice of the transference of the editorship of the above magazine from Dr. E. Krause to the author.

Humboldt Library No. 38. Geological Sketches. By Archibald Geikie. Part I.

Kant. By William Wallace, M. A. Philadelphia, J. B. Lippincott & Co. From the publisher.

Nature Series. Charles Darwin. London, Macmillan & Co., 1882. Contains notices of his life and character, work in zoölogy and work in psychology, by G. J. Romanes; his work in botany, by W. T. Thiselton Dyer; his work in geology, by A. Geikie, and an introductory notice by T. H. Huxley. All reprints from "Nature." From the publisher.

The Scientific Roll and Magazine of Systematized Notes. Climate. Vol. I, Part 2. Aqueous vapor. Conducted by Alex. Ramsay, F.G.S. London. From the publisher.

Some Observations on Ostriches and ostrich farming.

Sur les constructions turriformes des Vers de terre de France. Par M. E. L. Trouessart. Paris. From the author.

Description Lithologique des Récifs de St. Paul. Par A. Renard. Bruxelles. Ext. des Ann. de la Soc. belge de Microscopie. From the author.

Les Roches Grenatifères et Amphiboliques de la Région de Bastogne. Par A. Renard. Ext. du Bulletin du Mus. Roy. d'Hist. Nat de Belgique. From the author.

Notes on the Bartram oak (Quercus heterophylla Michx.). By Isaac C. Martindale. From the author.

Compte-Rendu des Seances de la Commission Internationale de Nomenclature Géologique et du Comité de la Carte Gèologique de l'Europe, tenues a Foix (France), Sept., 1882.

Dr. H. H. G. Bronn's Klassen und Ordnungen des Thierrichs. Sechster band, III Abtheilung. Reptilien. Leipzig und Heidelberg. From the publisher.

Catalogue of Mammalia in the Indian Museum, Calcutta. By John Anderson, M.D. Part I. Primates, Prosimiæ, Chiroptera and Insectivora. Calcutta. Printed by the trustees of the Indian Museum.

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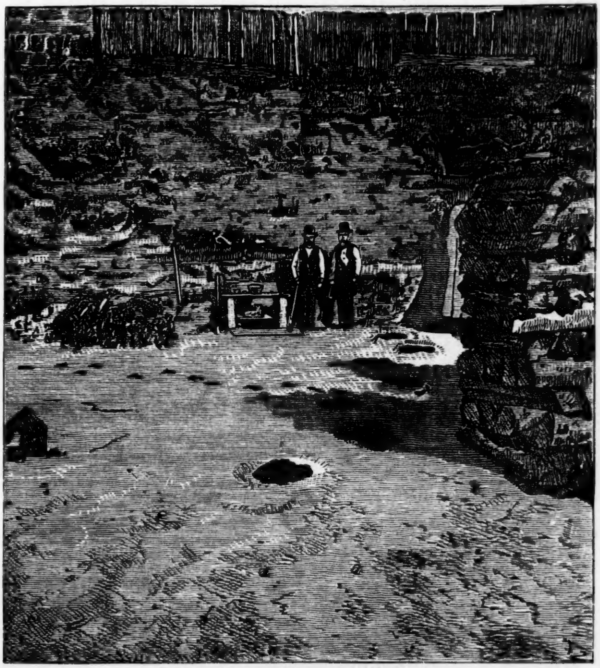
GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

ON UINTATHERIUM AND BATHMODON.—At a recent meeting of the Philadelphia Academy, Professor Cope exhibited a mandible of *Uintatherium robustum* of Leidy, which includes the symphysis. This region supports but two teeth, probably incisors on each side, which distinguishes the genus from Bathyopsis Cope, where there are four on each side. Its structure in this point had been previously unknown. He then exhibited some bones of *Bathmodon*, and showed that the genus differs from Coryphodon in the articulation of the astragalus. This element has a facet on its internal side not found in *Coryphodon.* It may be an articular face for a produced entocuneiform, or for a distinct bone or spine. The specimens exhibited represent the *Bathmodon radians* and a new and much larger species, to which the name of *Bathmodon pachypus* was given.

The Nevada Biped Tracks.—It is probable that the contemporaneity of man with the horse and other extinct Pliocene mammals in Western North America will soon be satisfactorily demonstrated. The first evidence on the subject was furnished by J. D. Whitney, chief of the Geological Survey of California, in the case of the Calaveras skull, which was said to be taken from the gold-bearing gravel; and in several other cases subsequently added. From the fact that scientific observers were never present at the unearthing of the remains of man and his



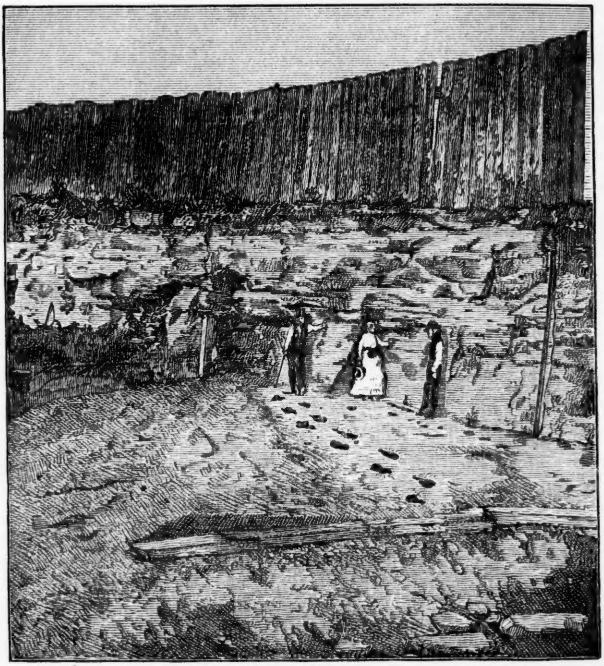
The Carson Mammoth Tracks.

works from this formation, the evidence has been generally regarded as inconclusive. The gold-bearing gravel of California is, however, a very peculiar formation, and an object once buried in it, would carry such marks of its origin as to be quite recognizable. This was the case with the Calaveras skull when first discovered, as I am informed by Professor Verrill of Yale College. This gentleman states that the skull was partially filled and covered with the hard, adhesive "cement" so characteristic of the formation.

I here refer to two observations of my own made in 1879, in

Oregon[1] and California,[2] which were confirmatory of the existence of man in the Upper Pliocene of both those States, but the evidence is in neither case absolutely conclusive.

The discovery that the tracks of several species of Pliocene Mammalia[3] in the argillaceous sandstones of the quarry of the Nevada State Prison at Carson, are accompanied by those of a biped resembling man, is a further confirmation of these views. The tracks are clearly those of a biped, and are not those of a member of the Simiidæ, but must be referred to the Hominidæ. Whether they belong to a species of the genus Homo or not,



The Carson Footprints.

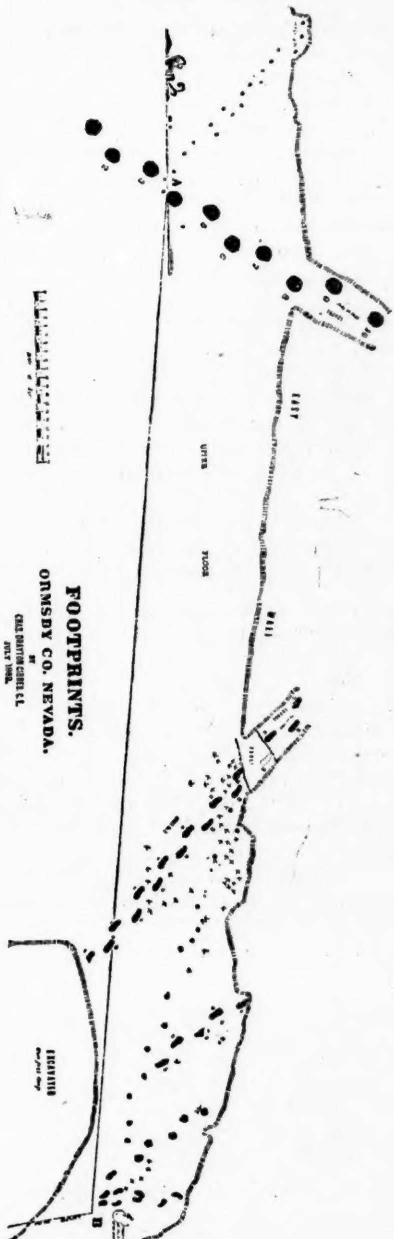
cannot be ascertained from the tracks alone, but can be determined on the discovery of the bones and teeth. In any case the animal was probably the ancestor of existing man, and was a contemporary of the *Elephas primigenius* and a species of *Equus*.

We give two cuts of these tracks, extracted from a paper read by Dr. Harkness of San Francisco, before the California Academy of Sciences.—*E. D. Cope.*

[1] American Naturalist, 1878, p. 125.

[2] Loc. cit., 1880, p. 62.

[3] Loc. cit., 1882, pp. 195 and 921.


FOOTPRINTS.
ORMSBY CO. NEVADA.

THE GEOLOGY OF CHESTER COUNTY, PENNSYLVANIA.—Some points in the geology of this region of considerable complexity have been recently worked out by Dr. Persifor Frazer, of the State Geological survey. The results are published in his These Premiére presented to the University of France, 1882. The structure of the limestone valley of Chester has long been under discussion. The northern hill is composed of sandstone and quartzite, the bottom of the valley of limestone, and the south hill of hydromica and chlorite schists and slates. The first two formations are the primordial and auroral, Nos. 1 and 2 of Rogers, or the Potsdam and Calciferous of Hall. The dip of these beds is south-east, and there is no reversed dip and no synclinal. Professor Fraser believes that a fault extends along the northern base of the south hill for forty miles, and that the oldest beds have been thrust up to form the south hill. The schists then are older than the Potsdam beds. Their dip is like the latter, south-east. South of this hill the schists descend and are succeeded by another limestone, which is in place between the former and the Potsdam beds. This formation is then considerably older than the limestone of the valley. Fraser calls it the Doe-run limestone. This is succeeded by the Potsdam again, and it in turn by the valley limestone, as in the valley itself. This latter bed appears in the region of Avondale and London Grove.

KOWALEVSKY ON ELASMOTHERIUM.—Dr. W. Kowalevsky has recently studied perfect crania of the *Elasmotherium typus* from the pliocene of the Volga. He shows that it is one of the *Rhinocerontidæ*, and that the genus differs from the others of the family in a most interesting way. It is related to them as the higher genera of the Equidæ are to the lower, and the higher genera of Bovidæ are to the lower, in three points—first, the molars are prismatic; second, their valleys are filled with cement; third, there are no incisor teeth. In the crimping of the enamel we have a species character of specialization. There is an osseous enlargement of the frontal bone, something like that of the giraffe, but much larger. The nasal bones are weak, and did not support a horn. It is proven that *Stereocerus* Duv. is identical with *Elasmotherium*. The genus stands at the top of the family, next to Cœlodonta. The *E. typus* was as large as the Indian rhinoceros. —*E. D. Cope.*

TWO NEW GENERA OF PYTHONOMORPHA.—M. L. Dollo, in the Bull. du Mus. Roy. d'Hist. Nat. de Belgique, describes the Mosasaurian remains in the Museum of Brussels. He forms from characters of the premaxillary and palatal regions, the new genus *Pterycollasaurus* to receive *Mosasaurus maximiliani* Goldfuss. He also proposes the genus *Plioplatecarpus* for the reception of a Mosasaurian resembling a *Liodon*, but which in the structure of its coracoid and maxillary teeth differs widely from that genus,

approaching more nearly to *Platecarpus*, Cope. The species, the remains of which were found near Maestricht, is named *P. marshii*. Mr. Dollo thinks that this animal possesses a sacrum of two vertebrae. It has also sclerotic bones. The genera of this order or sub-order are, then, eight in number, viz.: Baptosaurus Marsh; Pterycollosaurus Dollo; Mosasaurus Conyb.; Platecarpus Cope (*Lestosaurus* Marsh); Plioplatecarpus Dollo; Liodon Owen (*Rhinosaurus* and *Tylosaurus* Marsh); Sironectes Cope (*Holosaurus* Marsh); Clidastes Cope (*Edestosaurus* Marsh).—*E. D. Cope.*

SCUDDER ON TRIASSIC INSECTS.—At a late meeting of the National Academy of Sciences, Mr. S. H. Scudder announced the discovery of insects in the red beds near Fairplay, Colorado, which included a number of species of blattiform *Orthoptera*. These indicate mesozoic age of the rocks, and as they are below undoubted jurassic beds, Mr. Scudder refers them to the trias. It is, however a fact, that the numerous vegetable remains indicate, according to Mr. Lesquereux, to whom they have been submitted, a Permian age for the formation. The species are all either European, or identical with those from the permian of West Virginia. Here, again, the evidence from paleobotany is not coïncident with that from paleozoölogy. In the well-known case of the tertiary and Laramie formations, the plants indicate a later date than the vertebrata. In the present case they indicate an earlier age than the insects.—*E. D. Cope.*

SOME TERTIARY NEUROPTERA OF FLORISSANT, COLORADO.—Mr. S. H. Scudder[1] states that the Florissant strata, which are by Lesquereux and Cope placed immediately above the Green River shales, have yielded seven genera and twelve species of Planipennian Neuroptera, including five Raphidiidæ, four Chrysopidæ, one Hemerobiid, and one Panorpid.

The number of tertiary Planipennia known is already nearly doubled by the discoveries made in the American tertiaries. The Florissant beds have furnished six species of Odonata besides two larvæ. Two of these, and one larval form, belong to *Æschna*, the rest are Agrionina. The four species from the Green River shales are all Agriones. The resemblance of the faunas of the two localities is very apparent, though the species and even the genera are wholly distinct. The facies of both is decidedly subtropical.

GEOLOGICAL NOTES.—Recent numbers of the Annals and Magazine of Natural History contain the following articles: Notes on the Trochamminæ of the Lower Malm of Aargau (Switzerland), by Dr. R. Haeusler; Notes on fossil Calcispongiæ, by G. J. Hinde. This paper is devoted especially to those sponges which have been grouped by Professor Zittel in the family of "Pharetones,"

[1] Proc. Bost. Soc. Nat. Hist., Vol. XXI, p. 407, 1882.

and embodies some fresh facts regarding their spicular structure, as well as descriptions of five new species. From the close similarity between the minute spicular characters of these species and those of existing Calcisponges, the writer believes that the originally calcareous composition of the fossil forms can no longer be disputed. He also believes that the majority of the Pharetones possessed a "dermal layer of quadriradiate (?) spicules." The affinities of *Palæocampa*, Meek and Worthen, as evidence of wide diversity of type in the earliest known Myriopods, by S. H. Scudder.——In the October number of the Geological Magazine H. H. Howorth continues his argument in favor of the occurrence of a great Post glacial flood by examining the evidence of the Angular drift which overlies much of the land on either side of the English channel. The unrolled surface of these stones, the presence among them of land-shells and quadrupedal bones, the want of stratification, and the lack of marine beaches and of marine organisms throughout this layer, are to the author eloquent evidence of their deposition by a sudden and violent flood. The absence of river shells, and the lack, throughout the section of the English channel, of any smooth trough such as a river would form, are against the fluviatile origin of this drift, as is also the character of the drift itself, so widely different from the fine mud of the deltas. Mr. Howorth promises a farther argument, but hints that the flood he postulates is not a universal or Noachian deluge; H. Woodward has a note on *Ellipsccaris dewalquei*, a new Phyllopod crustacean shield from the Upper Devonian of Belgium; N. Flight continues his history of meteorites; T. F. Jamieson continues his enquiry into the causes of the depression and re-elevation of the land during the Glacial period; and J. S. Gardner gives suggestions for a revised classification of the British Eocenes. Mr. Gardner believes that the separation of a part of the series as Oligocene is artificial as regards England. The Oligocene strata of England are the Fluvio-marine series of the Isle of Wight.——The United States Geological Survey is prosecuting work in the old States as well as in the Territories of the West. Three parties are now surveying in the Southern Appalachians. Many of the employés are local geologists.

MINERALOGY.[1]

THE MECHANICAL SEPARATION OF MINERALS.— Mechanical methods for separating the minerals composing a rock are of great value in lithological investigations, and, where possible, should be employed in advance of chemical analyses. The best method is the now well-known one of using a liquid of great density, such as a solution of mercuric iodide, in which the pul-

[1] **Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.**

verized rock is suspended, and its constituents separated successively according to their specific gravity.

Another method, recently employed with success, depends upon the attractability of ferruginous minerals by an electro-magnet. The poles of a horseshoe electro-magnet are moved about through the pulverized substances, the strength of the magnet being increased at each succeeding experiment by the addition of greater battery power. Thus magnetite and hematite may be first extracted by a weak current, then follow ferruginous augites, hornblendes and garnets, while a stronger magnet attracts tourmaline, idocrase, bronzite, actinolite, etc., and, finally, by a still more powerful magnet, biotite, chlorite, muscovite, and even dolomite may be extracted. Minerals containing very minute percentages of iron may be attracted if the magnet is powerful enough. The gray powder of syenites and diabases may thus be separated in a few minutes into a white powder containing the non-feldspathic minerals, and a dark-colored one composed of the other constituents.

By employing the former method in conjunction with this, very accurate results may be reached.

A *phonolite*, for example, consisting of orthoclase, nephelite, augite and magnetite, was first freed from magnetite by a weak magnet, then, the strength of the current being increased, a mixture of augite and nephelite was extracted, which was finally separated into its constituents by the specific gravity method, mercuric iodide of proper density being employed. The composition of the rock was thus found to be, magnetite 4 p. c., augite 11 p. c., nephelite 48.5 p. c., orthoclase 25.5 p. c., impure feldspar, etc., 11 p. c.

Axinite from Bethlehem.—Through the medium of the late Professor W. T. Roepper, Pennsylvania mineralogists have been familiar for several years with the specimens of axinite from near Bethlehem, Pa., the locality having been discovered by Professor F. Prime, Jr. The crystals are small, and of a pale brown color, often nearly colorless, and have the axe-like shape which has suggested the name of the species. They occur with asbestos in a hornblendic rock, and, while devoid of the beauty possessed by specimens of the same mineral from other localities, are of some crystallograthic interest, as lately shown by B. W. Frazier, of Bethlehem. A close relationship has been found to exist between the crystallograthic characters of axinite and those of datolite. The axial lengths closely correspond, and a comparison of the angles between similar planes shows a remarkable agreement. They are found, moreover, to correspond in habit as well as in angles. Both minerals are silicates of lime and contain boracic acid, and it is very probable that the morphological resemblance is consequent upon a resemblance in chemical composition.

SAMARSKITE FROM CANADA.—Mr. G. C. Hoffman has found irregular fragments of samarskite in Berthier county, Canada. The mineral is massive, has a sub-metallic lustre, brownish-black color, grayish-brown streak, hardness of about 6, fusing between 4 and 4.5, and specific gravity of 4.947. Its composition, according to an analysis given in the Amer. Jour. Science, Dec., 1882, is as follows:

Cb_2O_5,Ta_2O_5	SnO_2	YO	CeO	UO_3	MnO	FeO
55.41	.10	14.34	4.78	10.75	.51	4.83

CaO	MgO	K_2O	Na_2O	F	H_2O
5.38.	.11	.39	.23	(trace)	2.21.

THE CRYOLITE GROUP OF MINERALS.—J. Brandl has investigated the chemical composition of the minerals of the Cryolite group, and derives several new formulæ. Pachnolite is shown to have the composition, AlF_3, CaF_2. NaF. Thomsenolite, often confounded with pachnolite, differs from it in composition by containing one molecule of water. New formulæ are also assigned to Ralstonite and Chiolite. Prosopite, Scheerer's analysis of which shows the presence of silicon, is now shown to contain no silicon, and the following formula is assigned to it: $Ca(MgNa)Al_2(F,OH)_8$. The rare mineral, Fluellite, has probably the formula, $AlF_3 + H_2O$.

HEATING APPARATUS FOR THE MICROSCOPE.—Thoulet describes in the *Bulletin de la Société Mineralogie de France*, a new method of heating objects upon the stage of the microscope. He has constructed a small "stove," or chamber, to rest upon the stage, and to contain the object and the thermometer. It consists of a glass tube fitting into a copper cylinder which rests upon a disk of copper, furnished with lateral prolongations, which can be heated by a gas jet. The whole is insulated by resting upon a disk of cork. The temperatuie of the chamber can be raised by heating the prolongations of copper and lowered by introducing a current of fresh air through a small tube fixed in the side. Very exact measurements can be taken with this simple apparatus, so well adapted for determining the temperature of the disappearance of bubbles in liquid inclusions, for studying the formation of crystals at various temperatures, or for other micro-chemical investigations.

MINERALOGICAL NOTES.—Descloiseaux has described some minute crystals which occur in Pegmatite near Nantes, France, and which probably are new. They are transparent, rectangular tables, less than a millimeter in length, which become white but do not fuse when heated, and are insoluble in acids. They are probably composed of a silicate of alumina, iron and lime, and are identical with some similar crystals previously described by Bertrand from another locality in the same region.——Mallard has just published a paper upon the action of heat upon crystallized

substances, in which his former conclusions regarding *pseudo-symmetry* appear to be confirmed.——Hintze reports the discovery of *Danburite* in Switzerland, on the Scopi. The crystals were at first thought to be topaz, which they closely resemble. The angles measured corresponded closely with those of the American mineral.——A nugget of gold, weighing forty-four pounds, has been found in the Ural district. This is the largest nugget ever found in Russia.——It is reported that natural sulphuric acid has been found in large quantity in Sweetwater county, Wyoming. The ground for a space of one hundred acres or more is impregnated with the acid, which is said to be of pure quality.

BOTANY.[1]

THE INTERPRETATION OF SCHWEINITZIAN AND OTHER EARLY DESCRIPTIONS.—In working up the flora of Iowa, it has been necessary in a number of instances to identify Schweinitzian species of microscopic fungi. I have had in the Herb. Curtis and Ravenel's Exsiccati, specimens upon the same species of host recorded by Schweinitz, and from the same immediate locality, to compare with his descriptions. In several cases I have been quite confounded to find that no reasonable interpretation of his language would make the descriptions fit the undoubted duplicates of the originals from which the descriptions were taken. The following instances, which have probably puzzled many other botanists, will serve as illustrations:

The uredineous fungus, abundant on various species of Lespedezæ, forming blackish spots on the leaves, and now known as *Uromyces lespedezæ*, is quite fully described by Schweinitz, under the genus Puccinia. He makes two species, one of which has spores that are distinctly two-celled or bilocular, and the other those that are sub-bilocular. In the former he says the "septum is situated *exactly in the middle* of the spore," while in the latter it is barely conspicuous (Syn. Fung. Car., p. 73). A glance under a common microscope, however, reveals the incongruous fact that the spores are but one-celled, and that there is *not even a shadow of a septum.* How is such an egregious blunder to be reconciled with the accuracy characteristic of science and scientific men? This cannot be a slip of the pen, for in his Synopsis of North American Fungi, published nine years later, there is no correction, and the species still remain in the genus Puccinia, which would not be the case if he had ascertained in the meantime that the spores were unicellular.

Another equally remarkable instance is that of the common Uromyces on Desmodium. In the earlier work the spores are said to be obscurely septate with very long pellucid pedicels (l. c., p. 74). In the later work he describes the species at greater

[1]Edited by PROF. C. E. BESSEY, Ames, Iowa.

length and adds that the pellucid pedicels are *jointed* (l. c., p. 297). As these spores have considerable resemblance to those of many Pucciniæ, and although but one-celled are quite opaque, we can almost make ourselves believe that, assuming the relationship from their general appearance, he easily persuaded himself that a septum must be present although not readily demonstrated. But this explanation will not do in the preceding instance, or in the case of the jointed pedicel, for both are transparent, and the latter perfectly colorless.

These are selected from plenty of such discrepancies between Schweinitz's descriptions and the objects described. It will not answer to throw such works aside and refuse to take trouble with an author who describes so carelessly, or, as it would seem, deliberately falsifies, for the law of priority in synomymy is inexorable, and early descriptions must be identified so far as possible.

Upon reflection, however, it does not appear probable that any one would falsify a scientific description, for there is no assignable motive for doing so, Let us rather look for a solution of the problem to the facilities possessed in the author's time for minute observations. Microscopes were then much inferior to our present instruments, and methods of manipulation not so well known. This was a suggestive idea, and I at once acted upon it by putting some of the dry spores under a low-power to see whether they looked the same, except in size, as when mounted in the usual way in water, and viewed under 350 diameters. A few spores scraped from the surface of the leaf were scattered on a glass slide, a half-inch objective used, magnifying about 75 diameters, and the key to the whole mystery was discovered.

The spores of *Uromyces lespedezæ* are much thickened at the apex, this thickening often occupying half the length of the spore, and it gives every appearance, under the conditions named, of a two-celled spore with a septum at or near the middle. The instance of the jointed pedicel is equally simple. The pedicels being delicate cylinders collapse when dry, and twist like a ribbon, and what appear to be three or four joints in each pedicel are very distinctly shown.

I have narrated this experience of mine chiefly for two reasons: (1) to give others this important key with which to interpret the writings of Schweinitz and other early systematists, and (2) to show the importance of noting very carefully the kind of instrument used and the methods employed in all microscopic work. —*J. C. Arthur, Ames, Iowa.*

WATSON'S "CONTRIBUTIONS TO AMERICAN BOTANY. X."—Mr. Watson has just sent out another of his interesting contributions as a pamphlet of 66 pp., extracted from Vol. XVII of the Proc. of the Am. Academy of Arts and Sciences. It consists of, I, A list of plants from Southwestern Texas and Northern Mexico, collected chiefly by Dr. E. Palmer in 1879–80; and, II, Descriptions

of new species of plants, chiefly from our Western Territories. The first includes the "Polypetalæ" only, and is much more than a list, containing descriptions of many species, and notes upon many others.

BOTANY IN MINNEAPOLIS.—The Summer School of Science at the University of Minnesota last year proved to be very popular. The session extended through the month of July, and was favored with delightful weather, only two or three days being at all uncomfortably warm.

The botanical part of the course, under Mr. J. C. Arthur, consisted of lectures, laboratory work, and collecting excursions. The botanical laboratory, supplied with simple and compound microscopes, was open from 9.30 A. M. to 6 P. M. Forty students availed themselves of its privileges.

A small part of the time was given to the study of plants with no other aid than the common hand lens. Besides illustrating a method of careful observation, it was designed to show that instruction need not be confined to flowering plants because a compound microscope is not obtainable. For this purpose four plants were used: dark green scum (Oscillatoria), large tree lichen (Parmelia), common liverwort (Marchantia), and milkweed (*Asclepias cornuti*).

The work with the compound microscope covered in the main the same ground as the lectures, which were as follows: 1. A survey of the science; 2. Protoplasm; 3. The cell, and cell-structures; 4. Protophyta, the sexless plants; 5. Zygosporeæ, the unisexual plants; 6. Oosporeæ, the egg-spore plants; 7 and 8. Carposporeæ, the red sea-weeds and their allies; 9. Bryophyta, the mosses and liverworts; Pteridophyta, the ferns and their allies; 11. Phanerogamia, the seed-bearing plants, (I) the conifers and their allies; 12. Same, (II) the flowering plants proper; 13. General histology of tissues; 14. Movement of water and gases in the plant; 15. Assimilation and metastasis; 16. Movements of plants; 17. Modes of fertilization; 18. Dissemination of seeds; 19. Insectivorous plants.

SYLLOGE FUNGORUM OMNIUM HUCUSQUE COGNITORUM. By Professor P. A. Saccardo, Padova, Italy.—The first volume of this long expected work has at length appeared and will help to satisfy a want that has long been felt by the students of mycology. The volume forms a large octavo of 768 pages, with descriptions of nearly 2900 species of Sphæriceous Fungi. Adding greatly to the practical value of the work are the *habitat lists* inserted after each of the different families or sub-divisions and giving in alphabetical order, names of the trees and plants on which the species grow, with numbers referring to the descriptions of the species found on each. The low price (49 francs) at which the volume is published places it within the reach of all.—*J. B. Ellis, Newfield, N. J.*

Dr. Gray's Revision of the Species of Echinospermum.—In the recently received "Contributions to North American Botany" by Dr. Gray in Vol. xvii of the Proc. of Am. Acad. of Arts and Sciences, the following corrections are made in the disposition of the species of Echinospermum, as given in Gray's Synoptical Flora of N. A., pp. 188 and 189.

E. virginicum Lehm.
E. pinetorum Greene; a new species from New Mexico.
E. deflexum Lehm.
E. ursinum Greene; a new species from New Mexico.
E. floribundum Lehm; "the synonym *E. subdecurrens* Parry is to be suppressed, as it belongs to the next."
E. diffusum Lehm; this is not the *E. diffusum* of the Synoptical Flora. (See below).
E. ciliatum Gray; this is the the *Cynoglossum ciliatum* Dougl. of the Syn. Flora. It also includes *C. howardi* Gray.
E. californicum Gray; this includes the large flowered specimens which in the Syn. Flora were described under *E. diffusum*. The true *E. diffusum* is the small-flowered species, specimens of which were mixed up with those of *E. californicum*.

The remaining species were unchanged.

ENTOMOLOGY.[1]

New Lists of North American Lepidoptera.—During the year 1882 three different lists or catalogues of Lepidoptera have been published. The first, issued in January, is "A check-list of the Macrolepidoptera of America, north of Mexico," published by the Brooklyn Entomological Society. In the preface the publication committee modestly disclaims all authority or intention to pass upon the validity of any of the species contained in the list, which is rather offered as filling a long-felt want by lepidopterists, to facilitate the exchange of specimens and the arranging of collections. Some 3204 species are enumerated, the Tortricina and Tineina not included. While by no means perfect, this list has the advantage of representing in most respects the views held by the bulk of lepidopterists. It is arranged on the general plan of Crotch's Check-list of Coleoptera (omitting, however, all synonymical matter), the works of Wm. H. Edwards, Boisduval, Staudinger, Stretch and Packard being followed, and the author of the species instead of that of the more recent generic combination being given. The list has proved very useful to lepidopterists, and will be followed, we hope, with supplements from time to time, or, what were better, new and improved editions.

The second publication we would call attention to, is something more than a list. It is very properly called "A Synonymical Catalogue of the described Tortricidæ of America, north of Mexico," by C. H. Fernald, A.M., professor of natural history in the Maine State College. It was issued by the American Entomological

[1] This department is edited by Professor C. V. Riley, Washington, D. C., to whom communications, books for notice, etc., should be sent.

Society in July. Working, as did the author, at this single family for many years before issuing the catalogue, this is, as might have been expected from Professor Fernald's well-known caution and ability, a work of exceptional value, and puts the study of the Tortricidæ in this country, at once upon a basis which it never had before. Not only are synonyms given with full references, but also the localities and food-plants, when known, though a number of these last which we have communicated to him are, for some reason, omitted.

We may have occasion to refer to this admirable catalogue in future, more to add some facts from our own experience than to offer any criticisms or suggestions; for the work is so admirable in every respect that it leaves little to be desired. Like every other cataloguer, Professor Fernald has found some difficulty in deciding what to do with many of Hübner's names, most of which, for the good of science, ought to be entirely ignored. Professor Fernald, after fully discussing the matter in his own mind, has decided to adopt the uniform specific termination of *ana*, and not to make it correspond in gender to the generic name. Although we have adopted the opposite course (Trans. St. Louis Ac. Sci., IV, p. 317 ff.) it was rather against our judgment as stated at the time, and we think Professor Fernald has acted wisely.

The third work is entitled a "New Check-list of North American Moths," by Aug. R. Grote, president New York Entomological Club. We wish we could speak as approvingly of this work as of the preceding, a condensed edition of which is included from advanced sheets furnished by Professor Fernald. Mr. Grote's list is more presumptuous than the Brooklyn list. The names are arranged in double column somewhat after the form of Crotch's list, already referred to, but without the advantage in this last of including the authority in parenthesis whenever the species was described under another genus than that with which it is now connected. The species in each family are independently numbered. While the typography and general make-up of Mr. Grote's list are all that could be desired (there is no indication as to publisher), it is marred by the author's accustomed looseness of statement and assertion. Within the space of a single page of the preface, we are treated to rambling thought anent eternities, deities, nature, matter, evolution, the universe, stars and suns, and to other matter in no way germane to a check-list of moths. Asserting on p. 7 his courtesy and fairness toward others, the list ends with a series of notes consisting chiefly of tirades against other entomologists, many of them including statements which are unjust and untrue.

There are a number of errors of commission or omission which it would be tedious in this connection to point out. New genera are made with a few words; some, hitherto abandoned, revived,

and others subdivided, without reason or explanation. There is, in short, too much arbitrary opinion that is not unbiased.

Yet with all these blemishes the list is an improvement on much from the same author that has gone before, and we are glad to note that he has rejected the system of attaching to the species the author who first referred the species to its modern genus —a system adopted and defended by him in a previous list. We also note a modification of his ideas of the value of Hübner's names, as he now unwillingly adopts one that does not rest on "real structural characters." We think that many more, on this basis, will have to be rejected. No uniformity of termination appears either in the family names or in those denoting minor divisions, and both *Noctuæ* and *Noctuidæ* are used in a synonymous way. In the list of catalogues and lists of North American Lepidoptera (p. 66), no mention is made of the excellent one of Bernhard Gerhard (Systematisches Verzeichniss der Macro-lepidoptera von Nord-Amerika, Leipzig, 1878) which was really the first published general list of the Macrolepidoptera of North America, and which, considering that it is by a foreigner by whom some omissions and defects are excusable, has much to commend it. Mr. Grote's list was not printed and issued till August (as acknowledged in a postscript) though on the cover, which is usually the last printed part of any work, "*May, 1882*," appears in large letters!

THE "CLUSTER FLY."—At a recent meeting of the Biological Society of Washington, D. C., Professor W. H. Dall exhibited living specimens of a fly which has proved to be quite a nuisance in the country houses near Geneva, N. Y. From a letter received by him from a relative living at that place, we quote the following extracts, which will explain the nature of this nuisance: "It is probably thirty years since the flies appeared in our neighborhood. I remember little about it except that they were at once a terror to all neat housekeepers, and from their peculiar habits a constant surprise. People soon learned to look for them everywhere: in beds, in pillow-slips, under table covers, behind pictures, in wardrobes nestled in bonnets and hats, under the edge of carpets, etc. A window casing solidly nailed on will, when removed, show a solid line of them from top to bottom. They like new houses, but are also found swarming in old unused buildings. Best of all they like a clean dark chamber seldom used, and if not disturbed form in large clusters about the ceilings. Under buildings, between earth and floor, they are often found in incredible numbers. About the 1st of April, or as soon as the sun shines warm in the early spring, they come out of the grass and fly up to the sunny side of the houses."

Dr. Frank Baker stated that he knew of the congregating of this fly in houses in Maine in the same manner as described by Professor Dall. One of their peculiarities, he said, was to crawl

and work into woolen stuff and yarn, apparently trying to suck up and extract the oily or fatty matter contained therein.

The flies received by these gentlemen were referred to us for determination. They proved to be the *Musca rudis* Fabricius, a species common to Europe and America, and redescribed by Harris (Entom. Corresp. of T. W. Harris, p. 336) as *Musca familiaris. Musca obscura* Fabr., and *Pollenia autumnalis* R-D., are also synonyms. Robineau Desvoidy, in dividing up the old genus Musca made *rudis* the type of his genus *Pollenia*, and enumerated about forty species. Although most of these species are very numerous in individuals, nothing definite is known in regard to their larval habits and development, though the last named author remarks that the eggs are laid in decomposing animal and vegetable matter.

The general habit of the species of entering dwelling houses in the fall of the year has been noted by both Harris and Robineau-Desvoidy, but we recall nothing in print that records their being such a nuisance to housekeepers. Enormous swarms of certain Diptera have occasionally been observed,[1] but no satisfactory explanation has so far been given for their formation. In the case of our Pollenia it seems to seek shelter in houses against the cold of winter; but the flies do not enter the houses in a single swarm as certain species of Chlorops have been observed to do; they gradually accumulate. The reasons why certain houses prove so attractive to the flies year after year, are difficult to explain. Wyenbergh (l. c.) records the swarming of *Pollenia atramentaria* and *P. vespillo* in the same building for seven successive years. His explanation that in this instance certain conditions facilitated the entrance of the flies but rendered their exit difficult, appears quite plausible.—*C. V. Riley*.

Naphthaline Cones.—Mr. C. Blake, of Philadelphia, has written us to the effect that our remarks on his naphthaline cones have given him a great deal of trouble in answering letters concerning the value of our experience. We admitted the value of these cones for collections of Coleoptera and Hemiptera, and other experienced entomologists have testified to their merits for other orders. We hope, therefore, that our own preference for other repellants will deter no one from giving the cones a trial. We would add that we have never attributed to the cones the power of *causing* the greasing of cabinet specimens, but simply of *encouraging*, in a similar way as does camphor, the tendency already existing. We have found that the glazed and relaxed appearance of our Lepidoptera which followed their use, was but transient, and due, doubtless, to the first rapid evaporation of the material which is often deposited on the insects in minute crystals. Mr. Blake claims further that the cones do not stain. Our experiences

[1] Vide H. Weyenbergh's paper on Dipterous swarms in Verh. Zool.-bot. Ver., Wien, 1871, Vol. XXXI, pp. 1201–1216.

differ. We find that they not only leave an unsightly brown mark wherever they touch the paper, but that by the time they have entirely evaporated and left only a sooty residuum, there is generally discoloration of the paper in the immediate neighborhood even where there has been no contact.

Our experience would indicate that the cones destroy mites and Psoci very soon, but have little effect on Dermestidæ.

Alternation of Crops versus the Wheat-Stalk Isosoma.—Professor G. H. French, of Carbondale, Ills., recently wrote us the following note: "I was in three wheat-fields yesterday, two that were in wheat last year and one in clover. The first two had about ninety-three per cent. of the stalks containing from one to three worms each; the other not more than 5 per cent. where examined—a good proof of the efficacy of the alternation of crops. The season was very favorable for the growth of the wheat, but the heads were short and not well filled at the ends."

Ravages of a Rare Scolytid Beetle in the Sugar Maples of Northeastern New York.—About the first of last August (1882) I noticed that a large percentage of the undergrowth of the sugar maple *(Acer saccharinum)* in Lewis county, Northeastern New York, seemed to be dying. The leaves drooped and withered, and finally shriveled and dried, but still clung to the branches.

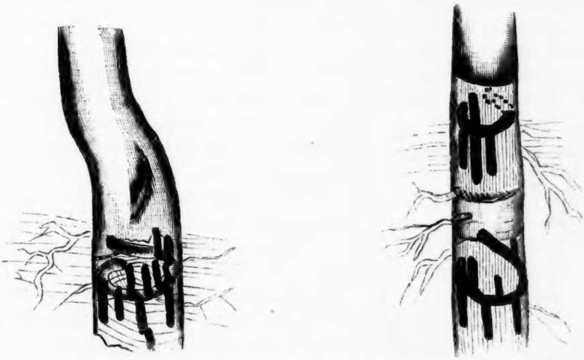
The majority of the plants affected were bushes a centimetre or two in thickness, and averaging from one to two metres in height, though a few exceeded these dimensions. On attempting to pull them up they uniformly, and almost without exception, broke off at the level of the ground, leaving the root undisturbed. A glance at the broken end sufficed to reveal the mystery, for it was perforated, both vertically and horizontally, by the tubular excavations of a little Scolytid beetle which, in most instances, was found still engaged in his work of destruction.

At this time the wood immediately above the part actually invaded by the insect was still sound, but a couple of months later it was generally found to be rotten. During September and October I dug up and examined a large number of apparently healthy young maples of about the size of those already mentioned, and was somewhat surprised to discover that fully ten per cent. of them were infested with the same beetles, though the excavations had not as yet been sufficiently extensive to affect the outward appearance of the bush. They must all die during the coming winter, and next spring will show that, in Lewis county alone, hundreds of thousands of young sugar maples perished from the ravages of this Scolytid during the summer of 1882.

Dr. George H. Horn, of Philadelphia, to whom I sent specimens for identification, writes me that the beetle is *Corthylus punctatissimus* Zim., and that nothing is known of its habits. I take pleasure, therefore, in contributing the present account, meagre as it is,

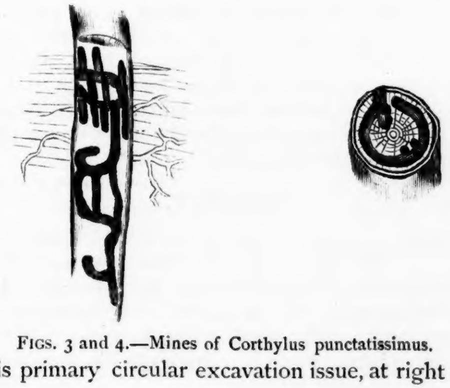
of its operations, and have illustrated it with a few rough sketches that are all of the natural size excepting those of the insects themselves, which are magnified about nine diameters.

The hole which constitutes the entrance to the excavation is, without exception, at or very near the surface of the ground, and is invariably beneath the layer of dead and decaying leaves that everywhere covers the soil in our northern deciduous forests. Each burrow consists of a primary, more or less horizontal, circular canal, that passes completely around the bush but does not perforate into the entrance hole, for it generally takes a slightly spiral course so that when back to the starting point it falls either a little above or a little below it—commonly the latter (see figs. 1 and 2).



FIGS. 1 and 2.—Mines of Corthylus punctatissimus.

It follows the periphery so closely that the outer layer of growing wood, separating it from the bark, does not average .25 mm. in thickness, and yet I have never known it to cut entirely through this so as to lie in contact with the bark.



FIGS. 3 and 4.—Mines of Corthylus punctatissimus.

From this primary circular excavation issue, at right angles, and

generally in both directions (up and down), a varying number of straight tubes, parallel to the axis of the plant (see figs. 1, 2 and 3). They average five or six millimetres in length and commonly terminate blindly, a mature beetle being usually found in the end of each. Sometimes, but rarely, one or more of these vertical excavations is found to extend farther and, bending at a right angle, to take a turn around the circumference of the bush, thus constituting a second horizontal circular canal from which, as from the primary one, a varying number of short vertical tubes branch off. And in very exceptional cases these excavations extend still deeper, and there may be three, or even four, more or less complete circular canals. Such an unusual state of things exists in the specimen from which figure 3 is taken.

It will be seen that with few exceptions, the most important of which is shown in figure 4, all the excavations (including both the horizontal canals and their vertical offshoots) are made in the sapwood, immediately under the bark, and not in the hard and comparatively dry central portion. This is doubtless because the outer layers of the wood are softer and more juicy and therefore more easily cut, besides containing more nutriment and being, doubtless, better relished, than the dryer interior.

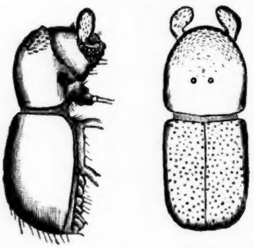


FIG. 5.–Corthylus punctatissimus.

This beetle does not bore, like some insects, but devours bodily all the wood that is removed in making its burrows. The depth of each vertical tube may be taken as an index to the length of time the animal has been at work; and the number of these tubes generally tells how many inhabit each bush, for as a general rule each individual makes but one hole, and is commonly found at the bottom of it. All of the excavations are black inside.

The beetle is sub-cylindric in outline and very small, measuring but 3.5 mm. in length. Its color is a dark chestnut-brown, some specimens being almost black. Its head is bent down under the thorax and cannot be seen from above (see fig. 5.)

Should this species become abundant and widely dispersed, it could but exercise a disastrous influence upon the maple forests of the future.—*C. Hart Merriam, M. D.*

ZOÖLOGY.

ON THE GREEN COLOR OF THE OYSTER.—In *Forest and Stream* in the issues of 25th May and 1st June last, an article by me which had previously been read before the American Fish Cultural Association, gave in the main the conclusions which I had arrived at in regard to this singular phenomenon. It is now well ascertained that *Ostrea virginiana* is affected in precisely the same

way as *O. edulis* and *O. angulata* of the Tagus, which I have been able to learn from fresh material from Liverpool, obtained for me through the efforts of Professor Baird. Additional investigations recently made have served to convince me that the coloration is *unquestionably* due to a tinction or staining of the blood cells of the animal, and that the coloring matter is either derived from without or else may be a hepatic coloring principle, which through some derangement of the normal metabolic processes of the animal, has been dissolved in the lympho-hæmal fluids and so been taken up by the blood cells or hæmatoblasts and given them their peculiar color. The blood cell of the oyster measures about $\frac{1}{3000}$th of an inch in diameter, but varies somewhat in size. It is amœbal in behavior to a surprising degree, throwing out pseudopodal prolongations which may even be branched. In a temperature abnormal to them at this season, I have had them live in a compressorium, bathed in their own serum, for four hours, during which time they exhibited the most surprising activity of movement, even becoming confluent with one another. The corpuscles which have been most deeply tinged appear to have lost their amœbal disposition, and when large quantities of green corpuscles have been freed from the meshes of the muscular trabeculæ of the ventricle, they exhibit a rounded form with no disposition to throw out pseudopods or to migrate. To this may be due the fact that they accumulate in the trabecular meshes on the inner surface of the heart and in cyst-like spaces in the mantle. They differ in no respect from a quiescent, normal, colorless blood cell of the oyster, except in color. The hypothesis of tinction which I have proposed, in no way disposes me to assign a less value to the influence of the food as the primary initiatory agency in effecting a staining of the internal ends of the cells which form the walls of the hepatic follicles. In fact, in certain lots of oysters most affected, the hepatic follicles are most deeply stained internally. I have failed to prove by spectroscopic research that this substance is chlorophyll, and my belief that it is chlorophyll at all, has recently been weakened by the fact that specimens which had the liver dyed deep green and were affected in other parts have shown no disposition to part with their coloring matter although immersed in strong alcohol for months, during which time it has been changed two or three times. Chlorophyll, so eminently soluble in alcohol during all this time, would also not be likely to retain its color, as its bright green tint slowly fades when in the form of an alcoholic solution. Wide differences are observable in the color of the liver of oysters; in some the follicles are reddish-brown, in others dark-brown, and in "greened" oysters they may be of a brownish-green. In sections these differences are very conspicuous.

The hypothesis of vegetable parasites, and a most airy one at that, seems to me in this case to have no foundation whatever.

The study of *Stentor polymorphus* and *Vorticella chlorostigma* have also served to convince me that so far as any evidence of green algoid cellular proliferation or multiplication within certain low forms has been more a matter of imagination than of observation. The detection of vegetal parasites of a wholly different character in a fresh-water mussel, by Leidy, is a case of an entirely different nature. They would be recognized as a thing entirely different from the green cells formed in the oyster, as well as equally distinct from anything which has been supposed to be ento-parasitic in green protozoa, judging from sketches which Professor Leidy has been kind enough to show me. Moreover, the color of the tinged and abnormal blood-cell of the oyster is very faintly green, vastly more faint in color than any normal chlorophyll grains as usually met with. I do not mean to imply that vegetable and animal coexistence—*symbiosis*, may not be a fact, but simply to point out that there are significant exceptions.

As if to aid in proving still more conclusively the views herein propounded to account for the green color of the oyster, I recently happened to open some native oysters for purposes of investigation, when I was rewarded by finding the pallial vessels mapped out as if they had had a pale greenish injecting fluid thrown into them. Here was occular proof to supplement that gained in a study of the tissues, vascular canals and heart of the animal by means of sections in both the living and dead condition. The most conclusive evidence as to the relations of the green blood-cells to the heart may be obtained from transverse sections of hardened affected specimens of the latter organ, the trabecular meshes of the walls of which have served to retain the abnormal cells in large masses or even as a thick adherent layer covering the whole of the internal parietes of the ventricles, and even extending down behind the auriculo-ventricular valves so as to impede their action. Contrasting this state of affairs with what is seen in a normal heart in which no such inter-trabecular deposits are discoverable, we find that the whole organ differs, too, from one which is affected, the former being translucent-whitish in life, the other of an opaque pea-green hue on account of the thick deposit of "tinged" corpuscles.—*J. A. Ryder.*

New and Rare Fishes in the Mediterranean.—Professor Hy. H. Giglioli contributes to *Nature* a note upon some fish-forms not hitherto noticed in the Mediterranean. One or two of these are new to science, while others were previously known only from the North Atlantic. Professor Giglioli intimates his belief that most of the species found at Madeira will eventually be found in the Mediterranean. The regions in which research was carried on were the coasts of Sicily, the Adriatic from Ancona to Lecce, and the Ionian Sea from Taranto to Reggio, and over two thousand specimens were taken. *Molva vulgaris* was taken both at Catania and Palermo; *Scorpæna astulata* Lowe, and *Umbrina*

rorchus Val., at Messina. Also, in November last, *Malacocephalus lævis*, and a species that is probably new, and may be allied to *Malacosteus*. This fish is deep black, with small eyes, and skin free from scales, and is evidently abyssal. A specimen of *Notacanthus*, perhaps the rarest of fishes, was also found. It is evidently nearly allied to *N. rissoanus* De Fillippi, yet differs from the description of that species. The harbor of Messina is a most favorable spot for obtaining deep-sea fishes, in stormy weather such forms as Chauliodus, Stomias, Argyropelecus, Microstoma, Coecia, Maurolicus, and ten or twelve kinds of Scopelus are thrown up in hundreds.

A CAVE INHABITING FLAT-WORM.—In May, 1874, while investigating the cave-life of the Carter caves in Eastern Kentucky under the auspices of the Geological Survey of Kentucky, Professor N. S. Shaler, director, I discovered in a brook in X cave, a Planarian which belongs to the Rhabdocœla, while the Planarian found by us in the brook in Mammoth cave is a Turbellarian. This is figured in our "Zoölogy" p. 141 under the name of *Dendrocælum percæcum*. The Rhabdocœlous worm found in the Carter caves belongs near Vortex, and it may provisionally be called *Vortex cavicolens*. The body is flat, elongated, narrow, lanceolate oval, contracting in width much more than is usual in Vortex. The pharynx is situated much farther back from the anterior end of the body than usual in Vortex, being placed a little in front of the middle of the body; it is moderately long, being oval in outline. The body behind suddenly contracts just before the somewhat pointed end. The genital outlet is about one-half as wide as the pharynx and orbicular in outline. Though described from two alchoholic specimens I can discover no eyes, nor do I remember seeing any when it was living, it was, when alive, white and apparently eyeless. Length 4 ^{mm}; breadth 1.5 ^{mm}. Found in X cave, one of the Carter caves, Eastern Kentucky.

Planarian Worm, Carter caves. *a*, dorsal; *b*, ventral; 6 × magnified; *c*, nat. size, ventral; *p*, proboscis.

This worm may not prove to be a genuine Vortex, the species of which are broad and blunt in front, with the pharynx much nearer the front end than in the present species, which is therefore only provisionally placed in the genus Vortex. In *Vortex cæcus* Œrsted the eyes, as the specific name implies, are wanting, but most of the species have eyes. As our species occurred in a brook in a dark cave, it would naturally, as in the case of the Mammoth cave eyeless white Planarian, be eyeless, and as a consequence of losing its eyes become white. Schultze in his Naturgeschichte der Turbellarien states that *Vortex viridis* in winter was generally without chlorophyll bodies and wholly white, but that in April the white individuals are rare. He then adds. "Kept for a considerable time in darkness the green animals become through bleach-

ing and the disappearance of the chlorophyll almost colorless."—*A. S. Packard, Jr.*

THE METAMORPHOSIS OF PENÆUS.—Scarcely another fact in morphological science, standing alone, exceeds in interest, says Professor W. K. Brooks, in the Johns Hopkins University circulars for November, 1882, the discovery that Penæus, a Decapod, passes through a Nauplius stage. Those familiar with the literature of the subject will recollect that Fritz Müller kept under observation until it changed into a Protozoëa, a Nauplius which he captured at the surface of the ocean. He also secured in the ocean, a very complete series of larvæ, through which he identified the Protozoëa with a young Macrouran with the characteristics of the genus Penæus. During the past summer, at the marine labratory of Johns Hopkins University, established at Beaufort, N. C., Professor Brooks has obtained the youngest Protozoëa stage of Penæus, the stage which Müller actually reared from the Nauplius." I have had the good fortune to rear this larva in the house, and to witness in isolated captive specimens every one of the five molts between the first Protozoëa and the young Penæus.

"Our boat is too small for work outside during the windy months of June and July, and as the ripe females do not come into the inlets and sounds, I have not been able to obtain the eggs or the newly hatched young; but this is the less important, as Fritz Müller reared his first Protozoëa from a Nauplius, so that we now have the entire metamophosis from actual observation."

[In 1871 we visited Charleston, S. C., partly for the purpose of working upon the development of Penæus. Unfortunately our visit, which was early in April, was too soon to enable us to find the prawn with eggs. None of those brought to the Charleston markets in April were spawning. We were informed that the prawn does not have eggs until May, probably the latter part of the month. The negroes catch them with sweep-nets.—*A. S. Packard, Jr.*]

THE GROWTH OF THE MOLLUSCAN SHELL.—The structure of the molluscan shell has been studied by means of sections of adult shells by Carpenter and others, and they have found that it presents an outer membranous horny epidermis and an internal stony portion. Such a method could not give any idea of the actual process of shell formation and a knowledge of this could be gained only by study of the first steps. To this end, edges of the shell were snipped away and a thin glass circle thrust between the animal and its shell, care being taken to prevent injury to the mantle. After the lapse of twenty-four hours the shell was opened and the glass circle carefully examined, others were allowed to remain two days, or three days, or for periods of weeks.

In twenty-four hours it was found that a film had been left upon the circle; in forty-eight hours, this film was plainly stony. The

earliest traces of this film when treated with coloring reageants, stain, but, when treated with acids, show no traces of lime, nor any evidences of structure; it is simply a structureless membrane. Later films, when treated with acetic acid, present the appearance of a tesselated pavement, and when examined with the polariscope and not treated with acetic acid show beautifully the presence of lime.

It would thus appear that the epithelium of the mantle pours out a secretion of horny matter which forms the epidermis; that this secretion holds lime in solution; and that from this the stony internal portion of the shell is formed. Experiments were successfully made upon the shells of the oyster and pinna and several other lamellibranchs, and some gasteropods were tried, but thus far in vain.—*H. L. Osborne in Johns Hopkins University Circular, No. 19, Nov., 1882.*

THE FRESHLY HATCHED YOUNG OF THE HORSE-SHOE CRAB.—On the second of last August, while Professor Dwight, of Vassar College, and myself, were collecting shells at Martha's Vineyard, he had the good fortune to discover a newly-hatched colony of Limuli. They were under the mat of seaweed lining the shore of one of the inlets. There must have been nearly a pint of them, and although out of water at the time were moving in a lively manner. The individuals were about four millimetres in length. —*T. J. Battey.*

SCOLOPENDRELLA IN ILLINOIS.—While searching the earth about the roots of corn to-day, for eggs of *Diabrotica longicornis*, I found a single Scolopendrella, which, on examination, proved to be so closely like the figures of *S. immaculata*, published in the NATURALIST for September, 1881, that I have no doubt that it belongs to that species, especially as it lacks the lateral bristles to the segments, and the angular outline of the head of *S. gratiæ* Ryder.

Since this specimen occurred in a cultivated field, careful search would probably discover the species almost everywhere in proper situations.—*S. A. Forbes.*

NOTES ON FISHES.—The fish described by Messrs. Goode and Bean as *Lopholatilus chamæleonticeps*, and also punningly called "tile-fish" by the same naturalists, has made itself celebrated by dying in great numbers in the spring of this year.

A great number of dead fish, mostly of a kind unknown to the fishermen, were strewn upon the surface between the Grand Banks and Barnegat, New Jersey, and on examination, were proved to be this fish. The dead fish formed a belt thirty to fifty miles wide, in which area they were strewn so thickly that it was estimated that fully fifty lay in the area of a bark's cabin.

When first reported they were in good condition, and proved excellent food. The cause of the mortality is unknown, but Pro-

fessor Baird is of opinion that concussion, caused by terrific storms, which raged off the banks, might probably account for it. The tile-fish was first discovered in 1879, was afterwards proved by the United States Fish Commission to occur in incredible quantities along the western edge of the Gulf stream at a depth of from seventy-five to one hundred and fifty fathoms, and was hoped to be a valuable addition to our food-fishes, as the quality of the flesh is excellent. It is to be feared that the mortality will for a long time prove a check upon the supply, as diligent search this summer failed to find the tile-fish in their accustomed haunts. Instead of it a few beautiful red fish, with very large and broad pectorals, afterwards found to be *Scorpæna dactylopterus*, were met with. The tile-fish belongs to the Latilidæ, but differs from Latilus in the presence of a large adipose appendage upon the nape, a little in advance of the dorsal fin, as well as in having a fleshy prolongation of the labial folds beyond the angle of the mouth. The upper parts of the body are dotted with yellow spots. It attains a weight of fifty pounds.

A singular flat-headed goby *(Dormitator maculatus)*, known to be common in the tropics, has, during the last five years become abundant in some bayous of the Mississippi, where they were previously unknown.

In October and November, 1880, at Bucksport, Orland, Maine, several hundred salmon were marked by a numbered platinum tag attached to the rear of the dorsal fin. Previous to June 26, 1882, five tagged salmon were recaptured, and several others showed marks of having been tagged. As more were taken in 1881, this experiment goes to prove that salmon which escape the dangers of the ascent and descent, visit the river again for spawning purposes two years after.—*Forest and Stream.*

THE WORK OF THE "TRAVAILLEUR."—The French have not led in the work of deep-sea exploration, but they are following in time to gather honors. The Mediterranean and the Bay of Biscay offered an ample field, untrodden by the tracks of the English or American exploring ships, and therefore these were chosen as the dredging-ground of the despatch-boat *Travailleur*, which the French government lent for the service of science. In July, 1880, the *Travailleur* did good work in the Bay of Biscay, while in the same month of 1881 she dredged in the Mediterranean around Corsica, across to Oran, and thence to Tangiers, whence she proceeded over the deep waters off the west coasts of Portugal and Spain into the Bay of Biscay. The number of new species encountered is probably less than have been obtained by other expeditions, but the short cruise, extending only from July 3d to August 20, has settled definitely a very important problem in geographical distribution, viz., the relations of the Mediterranean fauna to that of the Atlantic.

The *Travailleur* was provided with sounding apparatus similar

to that employed in the English expeditions; with dredges of the usual pattern, to which the commander, M. Richards, added two large nets whose mouths were kept open by iron frames; with Miller-Casella thermometers; and with "bouteilles à eau," ingenious bottles invented by M. Richards for taking samples of water at any determined depth.

The scientific work was thus apportioned: A. Milne Edwards, crustacea; M. de Follin, editor of "Les Fonds du Mer," rhizopoda; Professor Le Vaillant, fishes; Professor E. Perrier, echinoderms; Professor Marion cœlenterates and worms; and M. Fischer, mollusks and worms.

The depths of the Mediterranean, often 2600 metres below the surface, are covered entirely with a homogeneous, sticky mud, without so much as a pebble, but in certain places this mud is strewn over with an enormous quantity of the delicate shells of such pelagic mollusks as Hyalea, Carinaria, etc. This homogeneous mud, the result of the immense amount of sediment continually carried into this inland sea by the numerous rivers that flow into it, does not appear to offer favorable conditions for the development of animal life, since what most struck the attention of all the naturalists was the rarity of the organisms inhabiting the depths, when compared with the astonishing riches of the surrounding coasts. Throughout these depths, not only is there a monotony of muddy surface, but no currents change and agitate the water, and the temperature, beyond a depth of 200 metres, appears to be always 13° centigrade. The discovery in the Mediterranean of many forms believed to be peculiar to the Atlantic, and in the latter of those believed to be confined to the Mediterranean, has proved that the fauna of that sea had its origin in the ocean by way of the Straits of Gibraltar.

In this connection we cannot do better than translate the words of A. Milne Edwards, at the conclusion of his address to the Academy of Science, Paris:

"It results from our researches, that the Mediterranean ought not to be considered a distinct zoölogical province; the more its species are studied, the more it becomes evident that those forms believed to be limited to it can be found elsewhere.

"The observations made by the *Travailleur* lend a new force to this opinion. We believe that the Mediterranean is peopled by animals from the ocean. These finding in this recently opened basin conditions favorable to their existence, have established themselves there definitely; in many cases they have reproduced and developed themselves more actively than in their first habitat, and, especially near the coasts, the fauna shows a richness that the other European coasts rarely show. Some animals, placed in new biological conditions, are slightly modified in form or in other exterior characters, which explains the slight differences which may be observed between certain oceanic forms and the corresponding

Mediterranean form. The principal cause of the belief in the primordial distinctness of the two faunæ has been the comparison of the productions of the Mediterranean with those of the North sea, British channel or Brittany; instead of, as should have been the case, with those of Portugal, Southern Spain, Morocco and Senegal. The animals of these regions are those that first migrated to the Mediterranean, and as we become acquainted with the fauna of these regions, we shall see the differences zoölogists have noticed between them gradually disappear."

When once fairly outside of the Straits of Gibraltar, the monotony of the sea-bottom disappeared, sandy, pebbly and rocky areas were met with; the nets, which in the Mediterranean prevented the dredge from filling instantly with mud at the spot where it struck the bottom, became useless; and the temperature of the depths, owing to sub-marine currents, lost the uniformity so characteristic of those of the Mediterranean.

As a consequence of these varied conditions the forms of animal life increased in individuals and numbers, but among them, along the Portuguese coast, were found species heretofore considered exclusively Mediterranean.

At the entrance of the Bay of Biscay from the south, a remarkable inequality in the ocean bed was met with. A few miles beyond a sounding of 560 metres the astonishing depth of 4557 metres was found, and only thirteen miles further on bottom was reached at 400 metres—an irregularity scarcely to be paralleled by the highest chain of mountains.

The greatest depth sounded in the Bay of Biscay was 5100 metres, or about three and a quarter miles, and it was resolved to attempt to use the dredge at this depth. The operation lasted thirteen hours, and 8000 metres of cord were paid out, but the results, though only an annelid, amphipod and two ostracodes, proved the existence of tolerably high organisms at this great depth.

ZOOLOGICAL NOTES.—The eyes of the Proteus, according to M. Desfosses, are destitute of a crystalline lens, although they are provided with a retina. The blind subterranean fishes may need further study on this point.——In the last issue of studies from the Biological Laboratory of the Johns Hopkins College, E. B. Wilson describes a Nemertine larva of the Pilidium. It is helmet-shaped, with the convex side more elevated than usual, and crowned by a small flagellum. The anterior margin of the bell is produced into four short arms, behind which is a deep sinus, followed by two arms on each side, the anterior largest of all. The bell is transparent, its walls and lobes very contractile, and its outer and inner surfaces covered with cilia, which are longest on the margins of the lateral lobes. The young Nemertines are developed in a folded position, within the lower and posterior part of the larval envelope, and are distinctly segmented poster-

iorly.——M. F. Lataste (*Bull. Soc. Zool. de France*, Nov., 1881), describes a new species of Ctenodactylus, *C. mzabi*, a rodent of the Algerian Sahara. The remaining species are *C. massoni*, from S. Africa, and *C. gundi*, also from the Sahara. The toes of *C. gundi* are furnished on their inner face with horny tubercles, and probably similar tubercles were mistaken by Gray, in the Cape species for the "pectinated osseous appendages," that he insists on in characterizing the genus.——In the same volume, M. A. Certes narrates his experience with infusorian, and other germs. Water from Chott Timrit (Algiers), was evaporated in the sun in March, 1878. In April, 1881, the sediment was placed in boiled and filtered water, protected carefully from outside germs. Next day infusorians appeared, and in the beginning of June the nauplii of *Artemia salina* were visible, and rapidly grew.——In the Bulletin of the same Society for 1882, Dr. Dybowski brings together some interesting particulars respecting the family Mormonidæ (puffins). Eight species are known, one, *Fratercula arctica*, with two distinct races. The last species is peculiar to the N. Atlantic, while the other seven inhabit the N. Pacific, Kamtschatka, and the neighboring isles. Most nest in the crevices of rocks, but *Lunda cirrhata* prefer the plateaux on the margins of rocky islets. They leave Kamtschatka in October, and return at the end of May; a single egg is laid, and both sexes sit upon it.——In the *Annals and Magazine of Natural History*, the Rev. T. Hincks gives proofs of the homology of the *vibraculum* of the polyzoa, with the avicularium. The vibratile portion of the latter is an extension of the mandible, while the rest of the beak supplies a support and terminal notch in which the seta plays. Specimens of *Microporella ciliata* from various parts of the world, exhibit stages from the beak to the long seta, with its support, while in others it is modified into a flapper. In view of this instability of avicularian structure, the writer is disposed to differ from those who assign it a high value in classification.——The same writer, in the ninth of a series of contributions towards a general history of the Polyzoa, describes five new species of that group.——Mr. S. O. Ridley describes three new species of Gorgoniidæ, two from the Mauritius, and one from Burmah.——H. J. Carter describes a Cellepora of asteroid form, clustered around an empty shell, and a Palythoa of branched form, also on a shell, both from Senegambia.——The same naturalist describes twenty species of sponges, from the West Indies, and Acapulco, with valuable notices on other species. Among other facts, the author states that *Chondrilla nucula*, though nearly as hard as wood when dry, imbibes moisture and swells like the common sponge, becoming tough and elastic like India-rubber; and that *Spongia officinalis* of the West is identical with that of the Mediterranean, the Cape, and the world generally, coarser and finer forms occuring together. ——Prof. W. I. Sollas gives an exhaustive description of three

Tetractinellid sponges of Norway, with numerous figures of structure.——In the Morphologisches Yahrbuch bd. VIII, heft 1), E. Berger publishes an elaborate essay on the anatomy of the eye of fishes, illustrated by excellent histological sketches. ——The Annals and Mag. Nat. Hist. contains a preliminary notice by Professor McIntosh of a remarkable new type of aberrant Polyzoa allied to Rhabdopleura. It was dredged in the Straits of Magellan, and would readily be mistaken for a seaweed, since it is composed of a much branched fucoid tissue, tinged of a pale brownish hue and semitranslucent. This algoid mass or polyzoarium contains the minute animals which secrete this "house."——The Annals also has the conclusion of Barrois' general theory of the embryology of the Bryozoa. His conclusions are too long to reproduce here.——The Archives de Zoölogie Experimentale, No. 2, concludes Apostolide's elaborate anatomy and development of the Ophiurans, and publishes, with elaborate plates, Laffuie's work on the organization and development of Oncidium, a mollusk with dorsal eyes. The third number contains Vitzou's researches on the structure and formation of the integument of the Decapod Crustacea.——A fresh-water shrimp has been collected in ponds and ditches in Japan, by Dr. C. O. Whitman; it has been determined by E. J. Miers to be probably *Atyephyra compressa* De Hann sp. It is allied to Troglocaris, a shrimp which inhabits caves in Carinthia.——The Transactions of the Ottawa Fields Naturalists' Club contain a few original papers of zoölogical and palæontological interest, among them notes on the Ottawa Unionidæ, by F. R. Latchford, which contains a description by A. F. Gray, of a new species, *Unio borealis ;* descriptions of new species of bird mites, by J. B. Tyrrell, as well as a list of birds found near Ottawa.——In his seventh notice of the remarkable marine fauna occupying the outer banks of the southern coast of New England, Professor Verrill, in the *American Journal of Science* for November, gives evidence of a great destruction of marine life last winter, when the tile-fish and a wholesale destruction of invertebrate life took place. This was the result, probably, of a very severe storm, which occurred in this region, "which by agitating the bottom-water, forced outward the very cold water that, even in summer, occupies the great area of shallower sea, in less than sixty fathoms along the coast, and thus caused a sudden lowering of the temperature along this *warm zone*, where the tile-fish and the crustacea referred to were formerly found. As the warm belt is here narrow even in summer, and is not only bordered on its inner edge, but is also underlaid by much colder water, it is evident that even a moderate agitation and mixing up of the warm and cold water might, in winter, reduce the temperature so much as to practically obliterate the warm belt, at the bottom. But a severe storm, such as the one referred to, might even cause such a variation in the position and flow of

the tidal and other currents as to cause a direct flow of the cold inshore waters to temporarily occupy this area, pushing outward the Gulf stream water."——M. A. Milne Edwards, in the course of a summary of the work done by the *Travailleur* in the Mediterranean, mentions the capture of some Gobies, *Phycis mediterraneæ*, and *Plagusia lactea*, at depths not exceeding 450 meters, and of *Argyropelecus hemigymnus* at 1068 metres; many crustacea which were known only from the Atlantic, inhabit the abysses of the Mediterranean, and a new species of *Galathodes* (*G. marionis*) blind (like its congeners of the West Indian seas and the Bay of Biscay), and having eyes devoid of pigment, was found. Among the Bryozoa many remarkable species establish a passage between those of the Atlantic and the Mediterranean, while some were previously represented only by forms regarded as peculiar to the Cretaceous deposits. The three rare species of sharks taken at Cape Espichel (Portugal) in 1200 metres (*Centrophorus squamosus*, *C. crepidalbus*, and *Centroscymnus cœlolepis*), seem never to quit the abysses of the ocean.——Mr. B. Wright describes three Stylasterial and two Madreporian corals from the South seas.——Dr. A. Gruber describes two forms of Amœba in which the body is surrounded by a fine layer of clear protoplasm, which must be broken through before a pseudopodium can be protruded.——Dr. A. Günther, in a ninth contribution to the knowledge of the fauna of Madagascar, describes five new reptiles.——Dr. L. Orley presents a report on the Hematodes in the British Museum. He divides the order into: 1. Hematentozoa; thread-worms completing their early stage free, spending adult life as parasites, and laying immense numbers of ova; 2. Rhabditiformæ; small, chiefly microscopic, free thread-worms, becoming sexually mature in decomposing organic matter, living in colonies, and developing rapidly with either slight or sexually dimorphic metamorphosis. Exceptionally these may be parasitic; 3. Anguillulidæ. Microscopic thread-worms leading a free existence in mould or water, without complex metamorphosis, and producing large eggs.——Professor F. W. Hutton gives particulars of the structure and development of *Siphonaria australis*, states that it is a true pulmonate, and remarks that in their reproductive organs and dentition the pulmonates approach more nearly to the Opisthobranchs than to the Prosobranchs.——Mr. O. Thomas describes two new Muridæ (long-haired rats), of rather large size, from Tasmania.——G. A. Boulenger gives an account of the reptiles and batrachia collected by Mr. Whymper in Ecuador. The list includes a Cinosternon, an Amphisbæna, a new Coronella, and two species of Bothrops; in all twenty-seven reptiles, with twelve batrachia, three of them new.——F. D'Arruda Furtado notices a case of complete abortion of the reproductive organs in ten specimens of Vitrina from St. Michael's, one of the Azores.

PHYSIOLOGY.[1]

BENEKE ON CHOLESTERIN.—In the Proceedings of the Society for the Promotion of the Natural Sciences of Marburg, Prussia, for the years 1880 and 1881, Professor Beneke writes upon the role played by cholesterin in the brain of man. In the brain of a boy of fifteen, who died of phthisis, he found cholesterin to the extent of 2.34 per cent. of the fresh substance, and in that of a girl of nineteen who died of puerperal fever he found 2.13 per cent.

The presence of the substance in so large a quantity, militates, in the writer's belief, against its excrementitious nature, and tends rather to prove that it is "essential to the constitution of the protoplasmic matter of the structure of the tissues." It is present in both cerebrum and cerebellum.

In a second article, Professor Beneke gives further particulars of his investigations into the nature of cholesterin, and states his belief that the cilia of epithelium and of spermatozoa, the "cytozoa" of Dr. Gaule, the "spirilla" of Arndt, and the myelin threads (myelin-fäden) which he found to be procurable from carcinoma cells treated with alcohol, and form an alcoholic extract of blood corpuscles, constitute a connected series of similar objects having a common origin, and that in their production cholesterin plays an important part.

A CORRECTION.—In the September number of the NATURALIST, p. 744, seventh line from the bottom, I am credited with the statement that the part of the segmentation cavity which extends beneath the head of teleostean embryos is converted into the heart. This statement I repudiate; never having made it. What should have been said, by one familiar with my work on Tylosurus and Cybium, is as follows: The heart at first descends into this space, and in those forms in which the development of the heart may be traced in the living embryo, it appears as if the heart grew down into the segmentation cavity, guarded or fringed at its posterior or venous end by the posterior pericardiac membrane. This last point is elaborated in my last paper on the process of yelk absorption in *Alosa sapidissima* and will shortly be published in the Bulletin of the U. S. Fish Commission. In that paper I think I have conclusively shown that the posterior pericardiac membrane or septum, which at a later stage divides the pericardiac chamber from the body cavity is, in some species at least, often perforate or imperfect, or else, as in the clupeoids (*Alosa* and *Pomolobus*), the heart at its hinder or venous end is actually attached to the pericardiac septum by the ends of the walls of the venous sinus which opens directly into the segmentation cavity through a wide perforation in the septum itself. In this wise it results that the cardiac cavity is placed in direct communication with the serous space or segmentation cavity surrounding the yelk, and from the surface

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

of the *yelk hypoblast* (a thick structureless membrane with scattered proliferating nuclei embedded in it), the blood cells are directly budded off and pumped up by the heart into the circulation. This yelk hypoblast enters into the formation of no structures which can be discovered except blood cells. It is, in fact, the apparatus by which the yelk is broken down into corpuscles, and cannot enter into the development of the intestine, liver, pancreas, segmental organs or other viscera, as these have, at the stage I am discussing, already appeared. The only office it therefore has is a yelk-elaborating function, the yelk substance being incorporated into the body of the nascent fish by the ordinary metabolic processes of growth; the circulation only functionating, as the carrier of the material, the yelk hypoblast is therefore also an evanescent structure. These facts I have mainly observed in living material, afterwards studying the yelk hypoblast more carefully in sections. Kupffer and Gensch have noticed similar phenomena in teleosts, but have not apparently had the good fortune to witness the actual process of germination of the colorless primitive blood cells in the living embryo, as has been done by the writer. As might have been anticipated these early blood cells are colorless. This is in accord with what has been noted in the development of the blood of vertebrates much higher in the scale of organization. No writer on development, as far as I can discover, has hitherto recorded the fact that he has observed this communication of the heart with the segmentation cavity, such as may be seen in the just-hatched embryos of *Alosa*.—*J. A. Ryder*.

SENSE OF COLOR IN CEPHALOPODA.—C. Keller brings forward evidence, states the Journal of the Royal Microscopical Society, that the cuttle-fish manifests in a high degree the power of adapting the color of their skin to that of the environment. He was able to observe this adaptation of color in Eledone. In the Naples aquarium, a specimen of this octopod was under the necessity of escaping from a powerful lobster; during its flight, it appeared pale red; but subsequently, resting on a tuft of yellow rock covered with brown spots, resembled it so closely that it became almost invisible to the observer. In this case the conditions were decidedly very favorable for the occurrence, for yellow and dark-brown color cells occur in Eledone in large numbers. It should be added that the eye of the cuttle-fish shows an unusually high development.

PHYSIOLOGICAL NEWS.—Professor Wagener contributes[1] his researches upon the origin of the transverse striæ of muscles.——Professor Lieberkuhn gives a notice of the results of his studies of the germinal layers in the mammals, especially the mole and the porpoise (Meerschwein). The yelk-cells enter into the struccure of the ectoderm, as well as of the endoderm.——Dr. Strahl

[1] Proc. Soc. Promotion of Natural Sciences, Marburg.

writes upon the myloënteric canal of lizards, confirming the existence of a communication between the nerve canal and intestinal tract. The cells of the wall of the former pass directly into the endoderm of the latter in the young embryo, but the connection is obliterated in more advanced ones.——Professor Lieberkuhn treats of metaplastic and neoplastic ossification, as exhibited in the limb-bones of *Chelonia midas.*

PSYCHOLOGY.

Teaching Brutes the use of Letters.—The purpose of this article is to set forth briefly some thoughts upon a subject which appears to me to have been unaccountably neglected, considering the promise it presents of remarkable, and possibly practical, results.

It is manifest to all who are conversant with the subject, that instinct coöperates with reason in man to a far greater degree than was heretofore supposed, and that in early infancy it dominates; for it is impossible to deny the absolute automatism of the act of the child in obtaining nourishment in the natural manner.

Nor do I believe that the thoughtful and observing can deny that the brutes are capable of reasoning; that is, the apprehension of a logical sequence.

Candor, therefore, compels an admission of the truth that the difference between the mind of man and that of brutes is simply one of degree. It is also admitted that there is no reason to believe that the senses of their higher orders differ materially from those of man, save in some superadded refinements, the nature of which we can only conjecture.

Any investigation into the scope of their mental action, however, is embarrassed by the fact that the most intelligent and tractable are restricted in their power of communicating their ideas and desires to man, to a few simple signs and sounds which they have learned or invented, or derived through inheritance; and while our speech is heard and undoubtedly understood by them, they are practically dumb to us. They should be regarded therefore, as intelligent beings incapable of speech, and treated accordingly.

Now when we consider the apparently hopeless task (which has nevertheless been accomplished) of educating a person who was both deaf and blind;[1] the teaching of an intelligent dog, for example, the use of letters, would not seem to present insuperable difficulties, yet I have never heard of it having been attempted in a scientific spirit. I have seen some surprising feats of learned dogs and pigs, but have always understood that the master or a confederate, by some trick indicated to the animal the card containing the correct letter.

It is true that in a person devoid of the senses, there is neverthe-

[1] See life of Laura D. Bridgman, who lost sight and hearing by disease, when about two years of age.

less the brain full of inherited capacity for apprehension, yet when we close the avenues of sight and hearing, how inaccessible it becomes.

When we consider the immense variety that exists among our domestic animals, a large proportion of which is undoubtedly due to the application by man of the laws of heredity in breeding; and that too in an unenlightened manner; can it be doubted that the application of these laws, as now understood, to a race of dogs, for example, with the view of increasing their general intelligence, would result in something far more wonderful than a retriever or blood-hound.

It cannot be doubted that an intelligent dog is capable of distinguishing between the letters of the alphabet if of a good size and printed upon separate cards. The step between the recognition of the individual characteristics of a number of symbols and the ability to associate them with their respective sounds is not a great one. Then come words; certain symbols set in a certain order.

Having arrived at this stage, which, in view of the facts, would seem by no means impossible, the next task would be to establish the connection between familiar objects with short names, and their names spelled with the cards. The cards being arranged in alphabetical order, the dog would be taught to select the proper letters and place them in the proper order to spell the name of an object shown, without it being spoken. To save time, the *word method* might be adopted, a word being printed upon each card and taught as a simple, and not composite, symbol of the thing it represents.

From this point onward the investigation would become absorbingly interesting; how far the brute mind could understand and express a relationship between two or more objects, as a ball under a hat; a shoe on a box under a table, &c., would come next, and would lead the way to the qualifying function of adjectives.

This much accomplished, it would then be the province of an ingenious investigator to devise plans for bringing to the notice of his pupils abstract ideas; first simple ones, as heat and cold; then more complex, as kindness, friendship, &c. This might be impossible even with the most ingenious methods, yet it would be presumptuous to pronounce it so with our present knowledge of brute intelligence.

Then, too, it would be most interesting to note the operation of heredity upon the function of the brain in a race of creatures not subject to the vicissitudes of human life, and ruled by an intelligent hand.

I cannot but believe that ere long such an inquiry will be demanded, to throw light upon this important subject, and if possible, ascertain the limits of the capabilities of our dumb companions.—*Wm. B. Cooper.*

The Habits of a caged Robin.—I have a pet robin nearly eleven years old which fell from his nest before he was fledged, and so happy is he in his confinement, that he has never been known to beat against the wires of his cage. At first he was fed upon earthworms, spiders and such larvæ as we could obtain, but one day, such fare being scarce, we tried beefsteak, and found he relished it well, then bread, crackers, bread and milk, cake, &c., till for the last ten years his "living" has been anything usually found on the family table. Indeed, he has come to scorn common robins' food, save meal and cut-worms, spiders and flies. During his first winter, when the cook would be frying doughnuts, as soon as the heating lard began to smell, we noticed a peculiar teasing note, uttered only when wishing some new food. This led us to offer him a bit of hot doughnut, which he relished greatly, and the hotter the better, he eating it whilst quite too warm to hold in one's hand. As a farther test of his power of scent, we found that as soon as a paper of raisins, citron, or such fruits was brought into the dining-room, he began to tease, detecting the fruits as a cat detects the arrival of steak, while it is still wrapped in the paper. For any kind of cooked meat, save mutton, whether fresh or corned, he has a manifest relish.

In the hot summer days, when his food becomes too dry to suit him, it is his habit to carry it to the opposite end of the cage and dip it repeatedly in his bathing dish. As a result of this soft diet, and little or no gravel, his bill has a projection upon it fully three-sixteenths of an inch long, giving him quite a rapacious look, and his toe-nails have repeatedly become so long that he has hung himself on his perch, thus necessitating frequent clippings; now the nails of his hind toes, if straightened, would be more than an inch long.

In the summer he bathes five or six times daily, indeed it sometimes seems as though we could keep him in the water most of the time by refilling his bath-tub and stirring the water a little to call his attention; often his last bath is after tea, and his good night song is generally by gas-light. In early winter he frequently sings till 10 P.M. In January and February his notes are very soft and musical, becoming louder and louder as the season advances (we often have to cover him up to check his noise) till the last of June, when during the molting season he is perfectly silent, save a chirp with which he always greets the family. Indeed, if any of us chance to pass through the room in the night, be it ever so dark, he always welcomes our foot-steps, and with this chirp announces, too, the ringing of the door-bell, often hearing it when from its distance we do not.

Never having been with other robins, and frequently hearing the piano, his notes were a jargon of almost everything, till the usual inquiry of passers-by was: "What kind of a bird is that, a parrot, mocking-bird, or what?" And they were greatly surprised

to know it was only a common red-breast. The last three years the piano has been silent much of the time, and he has quite forgotten the songs he once followed, though still his notes are by no means those of the ordinary robin.

For his wild congeners he has never manifested any regard, and though when hanging out of doors they would sometimes perch upon his cage, especially the female robins, he never seemed to notice them. For persons he has always manifested an unquestionable preference, seldom changing his first impressions even upon acquaintance, and after being courted to do so by tempting morsels. To those he likes he will bring any loose thing at hand, but to others he utters a peculiarly sharp *quip, quip!* runs into the opposite corner of his cage, turns his back and looks decidedly indignant. Further, when singing, if such an one enters, he stops immediately. His memory of persons is perhaps the most remarkable thing about him. We had a servant girl some four years ago for whom he formed a very strong attachment, replying to her voice whenever he heard it, near or far, by another particular note, and when she came to him by going through with a great many funny antics. He had not seen her for three years, and had not made those sounds nor motions. Recently she called and said she wondered if "Fred" would remember her; sure enough, the first sound of her voice and glimpse of her presence revived his former habit, and he could not do enough for her. Is there anything beyond instinct in this?

Occasionally we let him out with a number of other birds in the sitting-room, and though so wise and so old, he has no courage to defend himself, being driven by even a little canary; indeed, he is miserable when out of his cage.

During the molting period there are usually many days when there is no appearance of tail or wing feathers and not more than a half dozen feathers still clinging to his head and neck. Whether this shedding of so many at once is the result of his peculiar food and life, I cannot say, but it is almost always so. He does not seem to be more delicate about his food, drink and bathing at these times than others.

He has never indicated any disposition to migrate, or even an uneasiness in the fall months; indeed, almost the only wild instinct manifested has been nest-building, tearing his paper into shreds and carrying them about, but not depositing them in any one place; nor does he incline to carry about bits of moist earth when they are put in his cage, as wild robins do. Though nearly eleven years old his feathers are as glossy as ever, and deeper in tint than those of his wild mates.—*Mary E. Holmes.*

THE NESTING OF THE BLACK AND WHITE CREEPER.—Birds, as well as men, are strongly affected by exterior circumstances and surroundings. Thus their habits, numbers or even individual presence in any specified district are not constant, but subject to

variation. In whatever sphere the scientist may direct his investigations he finds the word *change* engraven upon each object. This is especially marked in animate nature, and so reveals its presence in the feathered creation by readily observed effects. The agents through whose operation, either singly or collectively, this is traceable, are both numerous and varied. Civilization has modified or entirely changed the architectural structure of the nests of the barn and cliff swallow, &c. Peculiar surroundings leave their impress in certain departures from the general characteristics of any species, *e. g.*, purple grackles inland construct their nests of weeds, sticks, &c., whereas their relatives near the sea shore confine themselves almost entirely to eel grass in building their homes. But again, it sometimes occurs that members of the same species under almost identical exterior surroundings will still evince great inconstancy with no tenable explanation to account for the fact. The black and white creeper (*Mniotilta varia*) affords an illustration of this. There has been more or less controversy regarding the nest of this species. A plain, careful statement of facts alone are of value in all such cases. Many writers who are the theoretical exponents of the erratic or capricious habits of various members of the ornithological kingdom practically ignore all this and farther statements so positive and sweeping in their nature as to exclude the recognition of actual conditions of adverse nature, which obtain in another's personal experience. The result is, you are either compelled to doubt phenomena which have come under your own investigation, or else are led to question the accuracy, and so the value of any or all statements which emanate from such sources. But with all this, we have very little to do in the present article, which is intended to merely give the writer's experience regarding the nesting of this species and referring the reader to the statements of Drs. Coues and Brewer, quoted on page 98, of the Land and Game Birds of New England, and also Mr. Minot's own observations on the same page. The statements of Mr. Maynard in "Birds of Eastern North America," and Mr. Samuels in "Birds of New England and adjacent States," may be also consulted at leisure. During the past season, *i. e.*, in the latter part of April, 1882, the writer detected a pair of black and white creepers busily engaged in excavating for a nest in a white birch stump about five feet from the ground. The location was a clump of trees in a peaty swamp in Middlesex county, New Jersey. After having carefully and with much interest watched their mode of procedure, &c., we departed to return and pay them another visit, which occurred about ten days subsequent to our first discovery. The cavity was now examined and found completed, though no eggs had as yet been deposited in it. The owners of this snug home fluttered near us, evincing their displeasure and anxiety at our unwonted intrusion in an unmistakable manner. A severe rain

storm occurred in the interval, which elapsed ere our last visit. We now found much to our chagrin and disappointment that the nest was deserted. The spongy wood had absorbed so much water that the floor or lower part of the cavity was flooded, while the walls or sides were wet and soggy. But for this unlooked for severe storm, we should have had the pleasure of beholding a set of black and white creepers' eggs in a hole in a birch stump. Another nest also in a decayed stump contained young birds, when discovered in the latter part of May. In the spring of 1873, a friend, then attendant at the Blairstown Academy, situated in the north of New Jersey, while passing a ledge of rocks, was attracted by a long strip of bark depending from a crevice or chink in the rock. Curiosity to know what had carried this piece of bark induced him to examine the spot, the result was the discovery that the piece of bark was a portion of the material used in the construction of the nest of a pair of black and white creepers, the presence of whose home was thus betrayed. Eggs taken from this nest, now in cabinet, have been oft inspected by the writer.

In Indiana, Illinois, &c., persons there residing during visits to friends in New Jersey, have stated that in the West the black and white creeper not unfrequently nests in holes in fence rails, posts and like places, and by request have kindly expressed eggs taken from these situations. While, therefore, we do not say that this species does not nest upon the ground very often, we do state that we have as yet not so found the nest, though many others have. We also state that we have known them to nest in holes in trees, crevices in rocks, cavities in stakes, posts, &c. And finally we surmise that were it practicable, personal investigation is the better criterion in all mooted questions.—*A. G. Van Aken.*

A Bewildered Snow-Bird.—The night of the 10th instant was cold and rainy, with a high wind—a bad night for man, or bird, or beast, to be abroad. About 9 o'clock, as I sat by the table reading, with my back to the window, I heard a strange muffled rattling on the glass. Looking in the direction whence the sound proceeded, I saw a little bird fluttering up and down, evidently trying to get to the light. Going outside, I readily caught it. The little creature proved to be a snow-bird *(Junco hyemalis).* These birds are quite numerous in this vicinity, but this is the first instance of the kind that has come to my knowledge. I kept the little bird till morning, when I let it go. It flew off to the north, rising at an angle of about forty-five degrees, until it finally disappeared.—*Charles Aldrich, Webster City, Iowa, Nov. 12, 1882.*

A Toad's Cunning.—Charles White, of New Castle, has a brood of chickens which have the run of a portion of the yard, the old hen being kept shut up. The chickens are fed with moistened meal, in saucers, and when the dough gets a little sour, it attracts large numbers of flies. An observant toad has evidently noticed this, and every day, along toward evening, he makes his appear-

ance in the yard, hops to a saucer, climbs in, and rolls over and over until he is covered with meal, having done which, he awaits developments. The flies enticed by the smell, soon swarm around the scheming batrachian, and whenever one passes within two inches or so of his nose, his tongue darts out and the fly disappears; and this plan works so well that the toad has taken it up as a regular business. The chickens do not manifest the least alarm at their clumsy and big-mouthed playmate, but seem to consider it quite a lark to gather around him and peck off his stolen meal, even when they have plenty more of the same sort in the saucers.—*New Hampshire Gazette.*

ANTHROPOLOGY.[1]

DISCOVERY OF MOUND RELICS AT DEVIL RIVER, LAKE HURON. —Excavations made by me, last summer, in mounds at Devil river, on the west shore of Lake Huron, were rewarded by the discovery of many interesting relics. These principally consisted of the various parts of the human skeleton, together with fragmentary pottery. Among the former, flattened (platycnemic) tibiæ were abundant, also femora with expanded extremities (chiefly developed at the popliteal space), such as have been already described as found by me in the mounds of the Detroit river. Associated with these were humeri in which the lamina of bone ordinarily separating the olecranon and coronoid fossæ is partially obliterated or is perforated. The crania are of the orthocephalic type, bearing near resemblance to those of the same type from the mounds near Detroit. In all of them the occipital foramen is situated decidedly backwards. Most of the bones were in the more advanced stages of decay, and generally crumbled to pieces in the effort to secure them. But few stone implements were exhumed, and those were mostly of flint. Pottery was in large quantities, and though in fragments, evidently presented a great variety of shapes, being ornamented with indented designs, among which the cord pattern, as usual, predominated. A part of the perforated stem of a pipe, formed of clay, was among the relics. On the mounds originally stood pine trees (*Pinus strobus* L.), which must have been at least two hundred years old. The stumps of these, in numerous instances, remained, the great roots spreading in all directions above the bones and other relics, showing that the trees must have sprung up and attained their growth long subsequently to the burials.

On the low ground, toward the mouth of the river, is an ancient Manitou rock. It is a granite boulder and is deeply sunk in the earth; the part protruding being an angle rising only about a foot above ground, five feet long by two feet broad. Here, until the last six years, the modern Indians (of the Ojibway tribe) came annually in the autumn, in considerable numbers, to offer their votive gifts, which were deposited upon the rocks

[1] Edited by Professor OTIS T. MASON, 1305 Q street, N. W., Washington, D. C.

with great ceremony. The following year, at the same season, such of these offerings as remained were removed and preserved as charms or talismans, while similar gifts were put in their places. The offerings consisted chiefly of beads and the flowers of the pearly everlasting (Immortelles), known botanically as *Antennaria margaritacea* R. Br. It is noteworthy that similar flowers, probably from the same motive—their enduring character—are made use of by us to adorn the graves of our departed friends. The Indians buried their dead in the vicinity of the rock, which they regarded with the greatest veneration.—*Henry Gillman, Detroit, Michigan.*

Stone Image from Miami county, Ohio.—This object was found in Miami county, Ohio, near an ancient mound, in the spring of 1881. This mound is situated about two miles west of Stillwater river, at a point where the river hills gently melt away into a slightly rolling country. The mound presents the general appearance of most mounds in Western Ohio; the land having been cleared for some years, and the mound is now being farmed over; as a result the plow turned to the surface the turtle here mentioned. It is about four inches long and nearly two inches wide at the widest part of the body. The top part of the body terminates in a tolerably sharp ridge that extends from the center of the head to the tip of the tail. This ridge is slightly curved upward along the back, the head is accurately cut, and the eyes are knob-like protuberances and extend from the head about one-sixth of an inch. The tail is about three-quarters of an inch long, the bottom is flat and at either end is a hole drilled. One is bored obliquely from the neck to the base, and the posterior end is bored in a similar way. The material seems to be Tennessee granite, the yellow spots in the granite correspond to those on a turtle's back. We also have in our collection a sculptured alligator and duck.

Cup-shaped Stones in Pennsylvania.—Mr. William Kite, referring to a collection of hollowed stones brought from California by Mr. R. E. C. Stearns, writes that he has two in his possession found in Chester, Penna., and one from the outskirts of Germantown, Philadelphia. The latter is the more curious since it has the saucer-like cavity worked on both sides of the stone. There was found near it a celt much worn.

Phonetics of the Kayowe Language.—Mr. Albert S. Gatschet reproduces in the *Antiquarian*, Vol. IV, Part 4, his paper read at the Cincinnati meeting of the A. A. A. S., upon the phonetics of the Kayowe (Kaiowa) language. Comparative philologists have always been embarrassed in their researches by the confusion arising from the different methods of transliteration adopted by collectors of vocabularies. Mr. Gatschet attributes this disorder to three causes: 1. The sound-deafness of the writer,

similar to the color blindness of certain persons; 2. The effort to restrict a language to the compass of types already in use among printers, whereby many fine shades of sound are slighted; 3. Ignorance of the physiological laws of speech.

KAYOWE SOUNDS.

	Surds.	Sonant.	Aspirated.	Spirants.	Nasals.	Trills.	Vowels.
Gutturals	k	g	x	h,'	ng		e a, i
Palatals				y			
Linguals	*k*	*g*		sh		l	o
Dentals	t	d		s, z	n, nd, dl		
Labials	p	b	f	w	m, mb		u

In the consonant series the absences will strike any observer, and the two peculiar sounds are *k* and *g;* the two last being linguo-dentals produced by holding the inverted tip of the tongue against the hard palate and pronouncing k and g.

In the vocalic series the author unfortunately has elaborated from the five English vowels, a, e, i, o, u, fifteen sounds without indicating what they are equivalent to in English.

The chapter on alternation of sounds is a very important one, and leads to a comprehension of the different spellings frequently adopted by different authors for the same word.

The remaining papers of the *Antiquarian* are of the first rank and are well worthy of perusal.

ANTHROPOLOGY IN EUROPE.—For general information on anthropology no other journal can compare with the *Revue d'Anthropologie* of Paris, and No. 3 of Vol. v certainly sustains its enviable reputation. The reviews are even more valuable than the original papers. Of the latter there are five, to wit:

The mensuration of the capacity of the skull according to the registers of Broca. By Paul Topinard.

Essay upon the origin, the evolution and the actual condition of the sedentary Berbers. By Camille Sabatier.

Contribution to the study of palæoethnological classification of the age of rude stone. By Philip Salmon.

The population of the Balkan peninsula. By William Lejean.

The first discovery of human bones belonging to the stone age in Norway. By C. Arbo.

M. Topinard devotes twenty-five pages to the explanation of M. Broca's methods of craniometry, with all the precision of a text-book. Our readers engaged in craniometric researches should carefully examine this paper.

The Maures, or sedentary Berbers are divided into two branches, the *Getules*, "mountaineers," and the *Maziques*, or "cultivators." To these people, living in Algiers and Morocco, as distinguished from the wild Berbers, M. Sabatier devotes thirty pages. In their institutions we retrace the past, and are able to observe the evolution of a people. Inasmuch as they are of Cel-

tic origin, the subject becomes of more than passing interest for the French anthropologists.

Mr. Salmon outstrips all competitors in the *finesse* of his chart of archæology, in that region of guesswork where six blind men of Hindustan went out to see the elephant. Here it is:

I. Age of stone.	Period I. Stone flaked by fire,	Tertiary.
	Period II. Chipped stone,	Quaternary.
	a. Epoque Chelleènne or Acheulèen,	"
	b. Epoque moustèrienne,	"
	c. Epoque solutreènne,	
	d. Epoque magdalenienne,	"
	Period III. Polished stone,	Recent.
II. Age of bronze,		"
III. Age of iron,		"

Age I, Period I, is then elaborated, p. 451, into thirteen stages extending from the Lower Miocene to the Upper Pliocene.

M. Lejean's paper is continued from pp. 201–259 of this volume, and is indispensable to the ethnologist.

The purport of Dr. Arno's paper is sufficiently explained by the title.

On p. 520 M. Manouvrier reviews Hovelacque's "Les Races Humaines," The author divides our race primarily into Australians, Papuans, Melanesians, Bushmen, Hottentots, Guinea and Soudan Negroes, Akkas, Kaffirs, Peuls and Nubians, Negritoes, Veddahs, Dravidians, Moundas (savages of Indo-China), Siamese, Birmans, Himalayans, Indo-Chinese (east and south), Chinese, Japanese, Aïnos, Hyperboreans, Mongolians, Malays, Polynesians, Americans, Caucasians, Berbers, Semites, Aryans (Asiatic and European).

On p. 527 is a short sketch of M. Emile Houzé's studies on the crania of Flamands and Wallons. The prehistoric Belgians are neatly set forth in the following scheme:

Age of stone	Palæolithic epoch	Age of the mammoth	Race of Engis, Dolicocephalic.
			" " Naulette, "
		do. of reindeer	" " Furfooz, Sub-brachyceph'c.
	Neolithic epoch		" " Sclaigneaux, Brachyceph'c.
			" " Chauvaux, Dolicocephalic.
Age of metal, represented archæologically by	Eygenbilsen, limit of the bronze and the iron age.		
	Louette-Saint-Pierre?		
	Lustin, province of Namur?		

MICROSCOPY.[1]

Orientation in Microtomic Sections.—If any organic object has been cut ("microtomized") into serial sections and mounted, the value of the series for microscopical investigation will depend not only on the success with which each step in the preparation has been attended, but also on our ability to grasp all the topographical relations of each section. It is not enough to know the *region* through which a section passes; we must have the means

[1] Edited by Dr. C. O. Whitman, Newton Highlands, Mass.

of ascertaining to within a very small fraction of a millimeter, the exact path of the knife. Such precise orientation can only be arrived at in an indirect way; but the improved instruments and methods of section-cutting make its attainment a no very difficult task. To determine the *locus* of sections with accuracy, several conditions must be fulfilled. The sections must be made of *uniform thickness*, arranged in *serial order*, and all *similarly disposed*. With these conditions satisfied, the *plane of section* determined, and an accurate surface view of the object obtained prior to imbedding, it becomes an extremely simple matter to know what portion of the surface view is represented by any given section. The following data will furnish an illustration:

Blastoderm of the chick, 5^{mm} long.
Surface view magnified 20 diameters.
Thickness of each section $.05^{mm}$.
Plane of section at right angles to the long axis of the blastoderm.

From these data we know that there should be just 100 sections, and that each section must correspond to 1^{mm} of the surface view.

Now if we draw a line at one side of the surface view, parallel to, and of equal length with, its long axis, and divide this line into 100 equal parts, the number of the section will correspond to the same number on the scale, and the exact position of the section be recognized at a glance.

Of the conditions above named as essential to an exact knowledge of the locus of any given section, the only one likely to present any serious difficulties is that of obtaining sections of uniform thickness. Where the object-carrier and vernier are combined, and moved directly by the hand, it is extremely difficult, if not impossible, to obtain that degree of uniformity required for exact topographical study. In the best microtomes now in use, the carrier is moved only indirectly by the hand, through a micrometer screw, and its movements are thus brought under perfect control. Some space will be devoted later to the description of a microtome[1] which presents many important improvements on the old Rivet-Leiser microtome improvements that have originated with the gentlemen who are now associated in the management of the Zoölogical Station of Naples.

The Reconstruction of Objects from Sections.—The importance of attending to all available means of orientation will be best understood by those who know how to make use of sections in the reconstruction of objects or parts of objects. Suppose the only material at the disposal of an investigator to be a single small object, and that the rarity of the object renders its replacement extremely improbable. How shall the object be treated in order that the most exhaustive knowledge of all the details of its inner

[1] This microtome may be obtained from Rudolph Jung, optician and mechanic in Heidelberg.

structure may be obtained? One might be tempted to lock it up as a cabinet rarity, if he did not know how to make a single series of sections tell the whole story. If the preliminary steps have been correctly taken, it is possible to construct from serial transverse sections, a median sagittal (longitudinal and vertical) or frontal section, or a section in any desired plane. From the same series may be constructed also surface views of internal organs, which are inaccessible to, or unmanageable by, any of the ordinary methods of dissection.

It frequently happens that sections can be obtained by construction that could not be obtained by any direct means. For example, we may desire a frontal section of a vertebrate embryo that will show all the parts that lie in the same level with the chorda, or a sagittal section that will represent a median plane. It is evident that no such sections can be directly obtained, owing to the axial curvature of the embryo; but they can easily be constructed from transverse sections. It is here that we see some of the great advantages to be derived from the use of the microtome. It not only overcomes the opacity of objects, but it also enables us to represent curved and twisted surfaces in plane surfaces. The ability to construct sections at right angles to the actual planes of section is the key to the next and final step—" the plastic synthesis" of the sectioned object.

Method of Reconstruction.—Professor His was the first to make known the method of procedure.[1] Others have since made use of the same method for different purposes. A. Seessel, a former pupil of Professor His, employed it in a work on the development of the fore-gut[2]. Rosenberg made use of it in the contruction of frontal views of the sacrum[3]; and Krieger, in the investigation of the central nerve-system of the crayfish[4]. The method is well illustrated by two figures (11 and 12, Pl. XXXI), given by Krieger; and these figures are well worth examination, as they show how to proceed when the plane of section is not quite at right angles to the axis of the object. Professor His has also constructed frontal and profile (sagittal) views of the human embryo by the same method, and has explained the process in Part I, p. 10, of his "Anatomie menschlichen Embryonen."

For an illustration, we will take the data given under the head of orientation, and indicate how a surface view could be constructed from a series of transverse sections of the germinal disc of the chick. We should first draw 100 parallel zones on a sheet

[1] His. "Untersuchungen ü. d. erste Anlage des Wirbelthierleibes," p. 182, 1868. "Neu Untersuchungen ü. d. Bildung des Hühnerembryo, in Arch. f. Anat. u Physiol., anat. Abth.," p. 122, 1877.

[2] Seessel "Arch. f. Anat. u. Physiol., anat., Abth.," p. 449, 1877.

[3] Rosenberg Morph. Jahrb. Vol. I, p. 108, 1875.

[4] Krieger. Zeitschrift f. wiss. Zool. Vol. XXXIII, p. 531, 1880, and Zool. Anzeiger, p. 369, 1878.

of paper, each zone corresponding in thickness to a single section (1^{mm}).

A median line would then be drawn at right angles to these zones; this line would represent the length of the disc magnified 20 diameters (100^{mm}). We should next make an outline drawing of the first section enlarged the same number of diameters as before. The width of this drawing and its parts (primitive streak, embryonic rim, &c.), could then be indicated in the first zone by dots placed at the proper distance on the right and left side of the median line. The dots for each succeeding section having been placed in their corresponding zones, nothing further would remain to be done, except to connect the dots of corresponding parts in the several zones, and shade according to the requirements of the case.

If the plane of section is not quite perpendicular to the axis of the object, one has only to determine the angle which the axis makes with the plane of section, and draw the median line so that it forms the same angle with the parallel zones. Such a case has been clearly illustrated by Krieger.

In the construction of sagittal sections, a profile line (dorsal line, &c.), will serve as the ground line.

The Diffusion of Bacteria.—The researches of M. Pasteur and Darwin have shown how earthworms may aid the diffusion of small organisms, some of which may produce disease. Professor Schnetzler states that the dejections of earthworms always contain numerous living bacteria and their germs (the hay-bacterium included). It is clear that bacteria in enormous quantity float in the air about us; and we have at easy command, Professor Schnetzler points out, a small apparatus traversed by about 8000 cubic centimeters of air per minute, which may inform us as to those floating germs. This is no other than the nasal cavity, on the mucous surface of which air particles are deposited. To observe these he advises injecting the nose with distilled water (completely sterilized) by means of a glass syringe previously calcined. The liquid so obtained is put in one perfectly clean watch glass and covered by another. With a microscope magnifying 700 or 800 one finds, among various particles in the liquid, some real live bacteria. If the liquid be kept a few days in a clean glass tube hermetically sealed, the bacteria are found to have increased very considerably. One sees *Bacterium termo, Vibrio, Spirillum, Bacillus subtilis*, even some infusoria, and spores and fragments of fungi. Professor Schnetzler has further successfully cultivated the organized germs by means of a mixture of gelatine and distilled water. Why do not those bacteria in the nasal cavity always multiply and develop and penetrate to the windpipe and lungs? Their progress is doubtless opposed by the vibratory movements of cilia (or minute hairs) in the air-passages, and the weakly alkaline reaction of the nasal mucus may (it is also suggested) be un-

favorable to some of them. Cohn has proved that bacteria producing acid fermentation, perish in liquids with alkaline reaction. Infectious bacteria may, however, multiply to a formidable extent on living mucous surfaces; witness the growth of the micrococcus of diphtheria, brought by the air into the air-passages; also the bacterium of anthrax. The bacillus of tubercle, as Koch has lately shown, may be transmitted from one person to another by the air-passages. Professor Schnetzler thinks hay fever may also be due to bacteria entering the nose. While the development of bacteria on normal mucous surfaces is usually limited, millions of them are found in the dejections of healthy children.—*English Mechanic.*

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS, 1882.—This is a well-printed volume of 300 pages, containing valuable papers on improvements in the microscopes and in histological, botanical and zoölogical topics. Among the microscopical papers are the excellent address of the president, G. E. Blackham on the Evolution of the Modern Microscope; an interesting memoir of Charles A. Spencer, by H. L. Smith, with articles on light and illumination, by E. Gundlach; stereoscopic effects obtained by the high power binocular arrangement of Powell and Lealand, by A. C. Mercer; the improved Griffith Club microscope, by E. H. Griffith; A new freezing microtome, by T. Taylor; Modification of the Wenham half-disc illuminator, with an improved mounting, by R. Dayton; Micro-photography with dry-plates and lamp-light, and its application to making lantern positives, by W. H. Walmsley; The Fasoldt stage micrometer, by T. C. Mendenhall; Osmic acid, its uses and advantages in microscopical investigations, by T. B. Redding. On the conditions of success in the construction and the comparison of standards of length, by W. A. Rogers.

The botanical and general biological papers are: Microscopical contribution; The vegetable nature of croup, by E. Cutter; Micro-organisms in the blood in a case of tetanus, by L. Curtis; Microscopic organisms in the Buffalo water-supply and in Niagara river, by H. Mills; *Rhizosolenia gracilis*, n. sp., by H. L. Smith; Microscopic forms observed in water of Lake Erie, by C. M. Vorce; Sporadic growth of certain diatoms, and the relation thereof to impurities in the water-supply of cities, by J. D. Hyatt.

The zoölogical, histological and physiological papers are on certain crustaceous parasites of fresh-water fishes, by D. S. Kellicott—The termination of the nerves in the liver, by M. L. Holbrook; Observations on the fat cells and connective-tissue corpuscles of Necturus (Menobranchus), by S. H. Gage; The structure of the muscle of the lobster, by M. L. Holbrook; The wheel-like and other spicula of the Chirodota of Bermuda, by F. M. Hamlin; Fresh-water sponge by H. Mills; Polyzoa—Obser-

vations on species detected near Buffalo, N. Y., by D. S. Kellicott.

It would have been a convenience if the papers had been classified.

DESTRUCTION OF MICROSCOPICAL ORGANISMS IN POTABLE WATER. —Langfeldt, in seeking for a substance which would kill the living organisms without injuring the water for drinking purposes, found that citric acid (½ gram per litre of the water), killed all except Cyclops and those with a thick epidermis, within two minutes.

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SCIENTIFIC NEWS.

— In his interesting sketch of the progress of American mineralogy, delivered before the American Association for the Advancement of Science, at Montreal, Professor G. J. Brush, after speaking of the survey of the country adjacent to the Erie canal in 1820–24 by Professor Amos Eaton, who was placed in charge of the Rensselaer Polytechnic Institute, at Troy, says: "It may be interesting here, in these days of summer schools, to recall, although parenthetically, that what was probably the first summer school of science in the United States, was established more than fifty years ago in connection with this institution. The school consisted of a flotilla of towed canal boats, and the route was from Troy to Lake Erie. It took two months for the trip, and all important points on the way were visited. Instruction by lectures and examinations was given in mineralogy, geology, botany, zoology, chemistry, experimental philosophy and practical mathematics, particularly land surveying, harbor surveying and engineering." One of the largest boats in the flotilla was fitted up as a laboratory, with cabinets in mineralogy and geology, and also scientific books for reference. The students were taught the method of procuring specimens, and were required to make collections of whatever was interesting on the route.

— The Agassiz Association, an organization started by the *St. Nicholas* magazine, for the promotion of the study of nature by children, now numbers 3400 members. There are chapters in all our large cities and in our towns and villages. The aim is to induce children to look about them for insects, shells, minerals, flowers, etc., and to discuss in the meetings of their chapters the objects they discover, and to find out about them in accessible works on natural history. Mr. Harlan P. Ballard, of Lenox, Mass., the founder of the Society, has lately prepared a "Handbook of the St. Nicholas' Agassiz Association, designed as a guide to the study of natural objects, with directions for collecting and preserving specimens."

— The last Congress ordered the publication of the following entomological works which are now in an advanced state of

preparation: 2000 copies of the fifth report of the U. S. Entomological Commission, with the necessary illustrations. This will be an enlarged, revised edition of Bulletin No. 7, on forest and shade insects, with many additional illustrations. There was also ordered for the Department of Agriculture, 1000 copies of a Bibliography of Economic Entomology. This is in preparation by Mr. B. P. Mann. Of a report on orange insects 5000 copies were ordered for the use of the Department of Agriculture. The agricultural report, containing a lengthy report of the entomologist, is nearly ready for distribution.

— A steamer of 1000 tons, called the *Albatros*, has been built by government for the use of the U. S. Fish Commission, and is now, according to Professor Verrill, being fitted up expressly for deep-sea service, for which she will be, in every respect, well adapted, and will have the best equipment possible for all such investigations, and at all depths. During the past year improvements have been made in apparatus for deep-sea explorations, especially in deep-sea thermometers. New forms of traps for capturing bottom animals have also been devised. The "trawl-wings," first introduced by the commission last year, have been used the past season with great success, bringing up numerous free-swimming forms, from close to the bottom, which could not otherwise have been taken. The use of steel wire for sounding and of wire-rope for dredging has also greatly facilitated the work.

— Henry Chapman, for several years a member of the California Academy of Sciences, and recently curator of mammals and birds in that Institution, died on the 2d of December at the age of 55 years, from the effect of poison inhaled or absorbed in the course of his business as a taxidermist. Mr. Chapman was an enthusiastic naturalist, possessed of great energy and intelligence, exceedingly skillful in his special work, an efficient officer and member of the Academy, an excellent citizen and estimable in all the relations of life. His death is greatly lamented.—*R. E. C. S.*

— The *Tehama* (Cal.) *Tocsin* of recent date reports that an oak tree was cut down on Shelton's ranch, near Newville, Colusa county, that measured seven feet and four inches through at the stump. There was cut and split 400 posts, seven and a half feet long, and 75 cords (two-tier to the cord) of two-foot wood, out of it. One man worked forty-two days continuously and two men ten days. The posts are worth twenty cents apiece, and the wood two dollars per cord. It therefore yielded $230.—*R. E. C. S.*

— In a letter to *Nature*, Mr. Gwyn Jeffreys reports that Professor Giglioli made a few hauls with the dredge the past season in the Mediterranean in depths ranging from 389 to 857 fathoms. A rare and peculiar abyssal fish (*Paralepis cuvrieri*) was procured. A new water-bottle was tested, and also Capt. Magnaghi's new currentometer, "a most valuable discovery, by means of which

the direction and force of submarine currents can be accurately determined at any depth."

— Says the late Chauncy Wright in one of his essays: "According to Mr. Spencer's views, the first strata, had they been preserved, would have contained the remains of protozoa and protophytes; but, for aught we dare guess, they might have contained the foot-prints of archangels." Truth is stranger than fiction. What else can be the Carson footprints?

— The Cacao (*Theobroma cacao*) was some two hundred years ago extensively cultivated in Jamaica, but a hurricane that swept over the plantations, and high duties imposed in England, caused its growth to be discontinued. It is now in course of re-introduction, and it would appear that the Moisler valleys and hollows of the island are specially adapted to it.

— The British government has placed $20,000 at the disposal of the council of the Royal Society of London to aid scientific research. This is in accordanee with the custom of former years, and has been a healthy stimulus to scientific progress.

— We learn that Mr. R. E. C. Stearns has resigned his position as honorary curator of mollusca in the U. S. National Museum, on account of ill health, by the advice of his physician.

— Aristotle's "History of Animals" has been translated by Monsieur Bartholemy St. Hilaire, and the work will soon be published with preface, notes, and commentary.

— Professor J. Th. Reinhardt died at Copenhagen, October 23, aged 66. His works on birds and whales possessed great merit. He also traveled in Brazil, we believe. At the time of his death he was professor of zoölogy in the University of Copenhagen, and inspector of the Natural History Museum of that city.

— Dr. F. H. Troschel, professor of zoölogy at Bonn, and for many years one of the editors of the Archiv für Naturgeschichte, author of a treatise on zoölogy and of many papers, as well as a zoölogical artist of distinction, recently died at Bonn.

—Correction. On page 742, volume 16, eighteenth line, for "sub-connate" read sub-carinate.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, Nov. 10.—Communications were made by Professor J. W. Chickering, Jr., on the "Balds" of the southern mountains; by Professor C. V. Riley on the "Cluster fly," *Pollenia rudis;* by Dr. Geo. Vasey on the pines of North America; and by Dr. John A. Ryder on the rationale of the fattening process employed by oyster planters.

Nov. 24.—Communications were made by Dr. Elliott Coues on the present status of the avifauna of the District of Columbia; by

Professor C. V. Riley on jumping seeds and galls, with exhibition of specimens; by Dr. Thomas Taylor on the pear-tree blight, with illustrations; by Professor L. F. Ward on additions made to the Flora Columbiana during the season of 1882; and by Professor Theo. Gill on the Stromateidæ.

New York Academy of Sciences, Nov. 27.—A lecture on recent archæological discoveries relating to the mound-builders was delivered by Dr. J. S. Phené, of London, Eng.

Dec. 4.—The following papers were read: On the deposits of earth-wax (ozokerite) in Europe and America, by Mr. William L. Lay; The physical conditions under which coal was formed, by Dr. John S. Newberry.

Boston Society of Natural History, Nov. 15.—Dr. William B. Carpenter, F.R.S., of London, gave the result of his researches on *Eozoön canadense*.

Dec. 6.—Dr. Wadsworth read a paper by Dr. Alexis A. Julien, of Columbia College, on the Dunyte-beds of North Carolina; and the president (Mr. Scudder) gave an account of his explorations last summer in Colorado, and especially of the fossil insects found in some of the older rocks.

American Geographical Society, Dec. 4.—There was a discussion respecting the authenticity of the various portraits of Columbus, in which the president, Chief Justice Daly, and Mr. Nestor Ponce de Leon took part.

The Philadelphia Academy of Natural Sciences, May 16. —Mr. Meehan called attention to the fact that in England the male flowers of the hazelnut had been perfected this year before any sign of the female flowers appeared. This was in accordance with his observations in this State. Mr. Canby remarked upon an exudation of moisture from the tips of the leaflets in *Akebia quinata*. An examination by Professor Rothrock disclosed an arrangement of the tissue at the apex of each leaflet, evidently adapted to such an exudation. Mr. Meehan said that the liquid globules of this plant appeared indifferently in the day or evening, in dry or moist weather. *Mahonia aquifolia* had on its flower buds, similar globules, which collected until they formed drops as large as peas among the dense head of flowers. An exudation occurs also in coniferæ, and probably the pollen grain is carried to the nucleus as the moisture is absorbed within the vesicle.

Mr. Meehan also exhibited a series of cones from different trees of *Pinus rigida*, showing a change of forms from the typical *P. rigida* to a cone that could scarcely be distinguished from *P. serotina*.

May 23.—Dr. Leidy spoke of *Bacillus anthracis* in the blood of a cow that had suddenly died. The Bacilli were more numerous than the blood corpuscles. Dr. Leidy also described a small

worm found by him under stones at Media, Delaware county. Extremely like the common white worm, *Enchytræus vermicularis*, common in damp places, in flower-pots, under decaying leaves, or in marshy meadows, it differs from that species generically by the possession of two rows of setapeds instead of four. He proposed to name it *Distichopus sylvestris*. The intestine of Distichopus contained a Monocystis (*M. mitis*). The Enchytræus, instead of a gregarine, was infested, in different specimens, with two infusorians of the genus Anoplophrya (*A. modesta* and *A. funiculus* Leidy), and an undetermined Lumbricus yielded a third species (*A. melo* Leidy).

May 30.—Professor Leidy called attention to the abundance of the ant *Lasius interjectus* in the neighborhood of Philadelphia. It is habitual with this ant to care for an Aphis and a Coccus, both of which it guards in flocks. He described a particular nest under a flat stone, containing six distinct and closely crowded groups of the pale yellowish Aphis, and five of the red Coccus. Dr. Leidy also exhibited some transparent yellowish garnets and a colorless brilliant of tourmaline from St. Lawrence county, N. Y.

June 27.—Dr. H. Allen remarked that the pterylar tracts of birds were accompanied by an abundant supply of cutaneous nerves, and held that a study of these nerves would prove of value. In the anterior limbs of mammals, he had noticed that the deep muscles were supplied by long nerves, while the superficial muscles were supplied by short nerves. In Menopoma he had found a branch of the ulna nerve passing into the natatorial fold of skin upon the ulnar border of the forearm. In Menopoma the ulnar and musculo-spiral nerve arose from the same trunk, and he suggested as probable, that the deep connections of these nerves in the brachial plexus of man would be found to be constant. The ulnar nerve is distributed entirely to the hand and the muscles moving it, and is well developed in forms which lack the median, so that may be called the *manual* nerve. The muscles of the forearm that are supplied by this nerve, are singularly constant, are the most effective muscles in the backward movement of the manus in swimming and walking, and one, the *flexor carpi ulnaris*, makes tense that part of the bat's wing-membrane which lies between the manus and the body.

July 18.—Mr. Mehan exhibited a nest of the *Chaetura pelasgia*, made of cherry twigs fastened with gum, and suggested that the gum was probably cherry gum, and not, as stated by Audubon, a salivaceous secretion of the bird.

Miss Lewis said that she had, through a pipe-hole, watched a chimney-swallow at work, had seen it use its bill as a trowel, then wait for a further secretion, and then again work at adjusting the sticks.